

PRINTRONIX

MODEL P600 PRINTER FIELD MAINTENANCE MANUAL

PART NO. 103976

REVISION B

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INTRODUCTION

1.1 SCOPE OF THIS MANUAL

This field maintenance manual provides information required to maintain and repair the Printronix P600 Line Printer at a field site. The manual contains the following sections:

- Introduction
- Theory of Operation
- Preventive Maintenance
- Corrective Maintenance
- Adjustment, Removal and Replacement Procedures
- Appendix

1.2 GENERAL DESCRIPTION

The Printronix P600 (**Figure 1**) is a matrix line printer which receives text or graphics information from an external data system in digital code form, and presents the information in a hard-copy print-out on single or multi-part forms. The P600 prints text having up to 132 characters per line at rates up to 600 lines per minute (Refer to Table 1, Maintenance Specifications). Graphic information is plotted at rates depending on input code contents.

Plug-in PROM devices provide quick and easy changing of the printer character set. In addition to the standard character PROM set, PROM sets are available to provide foreign language sets and characters for block printing.

Standard interfaces are logically and electrically compatible with controllers intended to communicate with Centronics or Data Products line printers.

Special program controlled features of the P600 include the following:

- Elongated (double-height) characters
- Character underlining
- Selectable line spacing
- Electronic Vertical Format Unit (EVFU)
- Programmable vertical tab
- Double density plotting

1.3 MAINTENANCE SPECIFICATIONS

Specifications pertinent to the maintenance of the P600 printer are listed in Table 1.

TABLE 1 - Printronix Model 600, Maintenance Specifications

Specification	Characteristics	
CHARACTER PRINTING		
Print Rate (lines per minute)		
Upper case	600 +4.0%, -4.5%.	
Underline or lower-case descenders	465 +4.0%, -4.5%.	
Elongated (high) characters	320 +4.0%, -4.5%.	
Character Matrix	<u>Horizontal</u>	<u>Vertical</u>
Upper case	5 dots on 9 ½ - dot centers.	7 dots.
Lower case with Descenders	5 dots on 9 ½ - dot centers.	9 dots.
Optional sets	6 dots on 12 ½ - dot centers.	9 dots.
Horizontal Line Format	132 characters per line, 10 characters per inch.	
Vertical Line Format		
Standard	6 LPI and 8 LPI.	
Optional	6 LPI and 9 LPI. 6 LPI and 10 LPI. 8 LPI only. 10 LPI only.	
Character Set		
Standard	96-character ASCII set.	
Max. extension with optional fonts	160 characters.	
Plot Resolution (dots per inch)	60 horizontal, 72 vertical.	
Plot Rate (inches per minute)	33-1/3.	
Paper Type	Edge-punched, fanfolded, one to six parts, up to 16 inches wide.	
Paper Drive	Stepper motor driving adjustable tractors with 8-pin engagement.	
Paper Drive Speed		
1/6-in. Step	10 msec max.	
1/8-in. Step	8.5 msec max.	
Slew (in. per second)	16 ± 0.5 ips.	
Forms Control	11-in. electronic top of form. 1/2-in. to 1-in. perforation skipover. Standard Electronic Vertical Format Unit, 14 channels, 132 lines. Optional Forms Length Switch, one to 99 lines.	
External Operator Controls	POWER ON/Off. Top of Form. On Line/Off Line. 6 LPI/8 LPI. Paper Advance. Check Reset. Self Test (Simultaneous Paper Advance and CHECK Reset).	

TABLE 1 - Printronix Model 600, Maintenance Specifications (continued)

Specification	Characteristics
Internal Operator Controls	Forms Thickness Adjustment. Horizontal Vernier. Vertical Positioning.
Operator Indicators	POWER On. CHECK EVFU Loaded/Forms Length Active 8 LPI. ON LINE.
Standard Interface Format	8-bit parallel, ASCII codes.
Interface Signal Levels	TTL (7406/7414) logic levels: Low = 0.0V DC to 0.8V DC; High = 2.0V DC to 5.5V DC.
Data Transfer Rate	
Dataproducts Compatible	Up to 500,000 characters per second.
Centronics Compatible	Up to 200,000 characters per second.
Interface Options	RS-232/Current Loop. Dataproducts Long Lines.
Power Requirements	
Voltage	100V, 110V, 120V, 200V, 220V, 240V AC (+10%, -15%); Single-phase.
Frequency	50 Hz or 60 Hz \pm 3%.
Power Consumption (at 60 Hz)	
Nominal Standby	216 VA
Nominal Operating	720 VA
Motor Startup	25.4 amperes for 0.5 second.
Ambient Temperature	
Operating	10° C to 38° C.
Storage	-40° C to 65° C.
Humidity	
Operating	30% to 90% (10% to 90% with Static Eliminator option).
Storage (without condensation)	5% to 95%.
Dimensions (inches)	Height 16.5, Width 30, Depth 24.25
Weight	185 pounds.

1.4 REFERENCE DOCUMENTS

Other documents associated with the P600 include the following:

- **Drawings Manual**—contains electrical, electronic, and assembly drawings to aid in maintaining and repairing the printer.
- **Operators Handbook**—contains instructions and information for unpacking and installing the printer, and for using basic operator controls on the printer.
- **Applications Manual**—contains instructions and information for programming and configuring the printer.
- **Option Instruction Manuals**—describes the functions and application of the different optional features available for the P600 Line Printer.
- **Illustrated Parts Breakdown (IPB)**—aids in parts identification and printer repair.
- **Application Notes**—details specific information about the option.

These manuals are offered by Printronix to aid the user in getting the greatest possible value from the P600 Printer.

THEORY OF OPERATION

2.1 GENERAL

Section 2 presents the theory of operation for the Printronix P600 Line Printer. The information presented is intended to give the maintenance technician enough knowledge and understanding to effectively service the printer.

The mechanics of printing is to create characters by placing dots in a matrix. The matrix, control logic, scheme of changing input codes to character generation and paper motion will be discussed in detail.

The following paragraphs provide a general functional description of the printer operation, followed by a detailed description of printer functions, mechanisms, and logic circuits. Refer to the **P600 Drawing Manual** for specific logic circuit details.

2.2 FUNCTIONAL OVERVIEW

Figure 2 diagrams the printer functional blocks and their relationship with other logic and mechanisms. Each block lists its function and the PCBA which contains it. The following pages describe the operation of printer logic and circuits. Refer to illustrations accompanying the text and to these logic, schematic, and assembly drawings contained in the Printronix Model P600 Drawing Manual (P/N 105485).

Printer operation is explained for each of the three principle states of operation, which are:

- a. The Load Buffer state—A line of data to be printed is received from the remote control and stored in the printer buffer.
- b. The Print state—The last received line of data is printed and the paper is advanced to the next dot row or the top of the next line.
- c. The Paper Feed state—The paper is advanced or slewed. It is advanced to the next line. It is slewed to the top-of-form or to a line specified by a EVFU command.

Described under separate headings are:

- a. The interface logic through which the printer communicates with the controller.
- b. Circuits on the Hammer Driver PCBA.
- c. The Electronic Vertical Format Unit (EVFU).

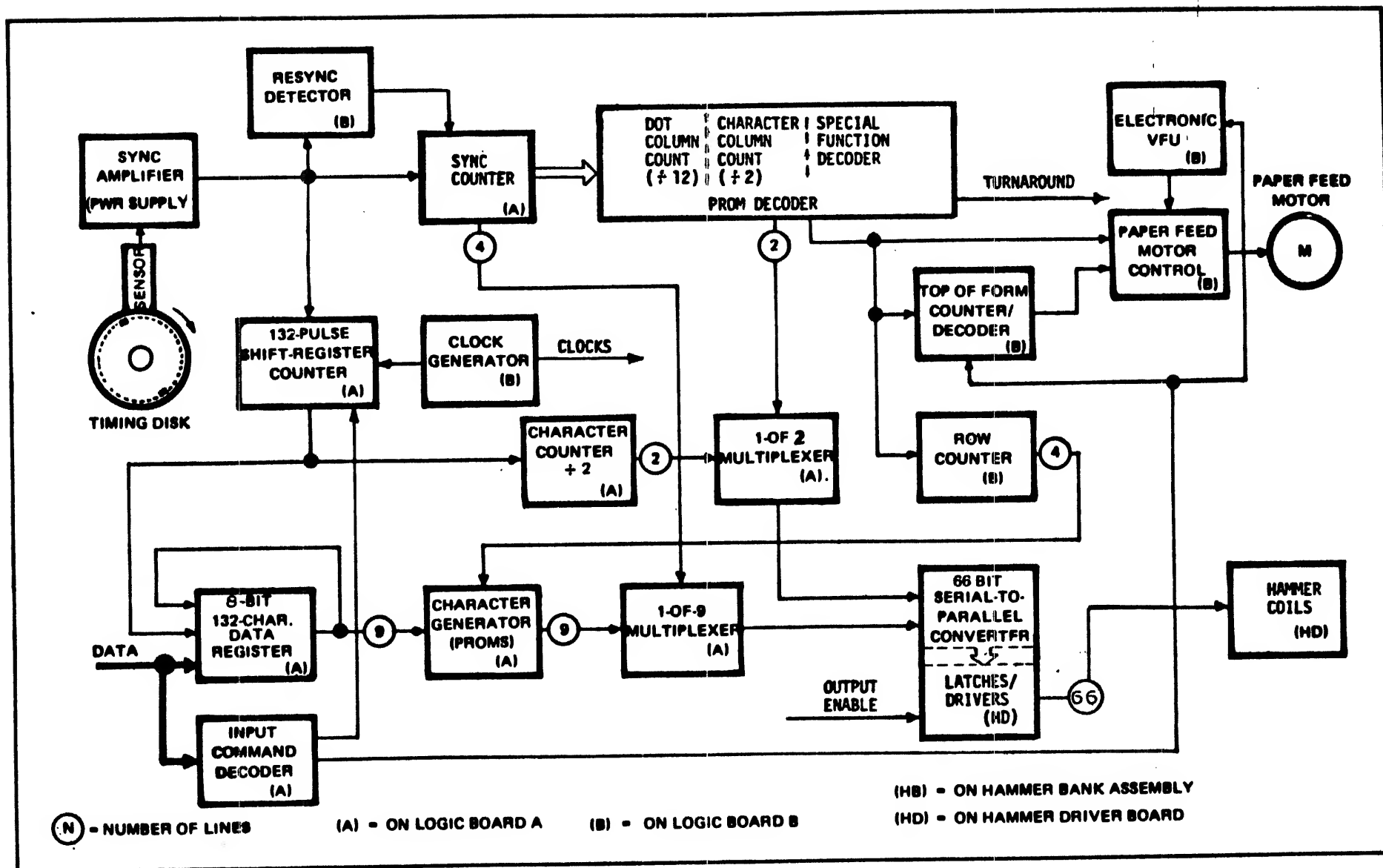


Figure 2 Printronix P600 Functional Block Diagram

- d. Ribbon control circuits.
- e. Power supply circuits.

Figure 3 is the overall timing diagram for printer operation.

Some conventions used in the illustrations and logic diagrams include the following:

- a. The letter N, beginning a signal mnemonic, indicates that the low level is true. For example: NDSTB (low true), DSTB (high true).
- b. Interface signals are identified by the letter I. For example: IDR.
- c. Letters in the block diagram (**Figure 2**) indicate that the logic elements are located on the Logic A PCBA (A), the Logic B PCBA (B), or the Hammer Driver PCBA (HD).

A complete glossary of mnemonic terms is contained in the Appendix.

2.3 LOAD BUFFER STATE OPERATION

In the Load Buffer state of operation each printable character, space, or underline appearing at the interface latches is clocked into the printer buffer and the Load Buffer state continues. **Figure 4** diagrams the Interface logic and **Table 2** defines the interface signals.

The printer buffer is a 9-bit, 132-character recirculating shift register made up of dual 132-bit shift register devices. (**Figure 5**). One shift register is used for underlines and the other is used for the remaining printable characters. **Figure 6** represents the logic for a typical 132-bit shift register device.

The printer buffer may be loaded only when the printer is neither in the Print state (PRT), nor the Paper Feed state (PPF). PRT and PPF are then false, making Load Buffer (LB) true.

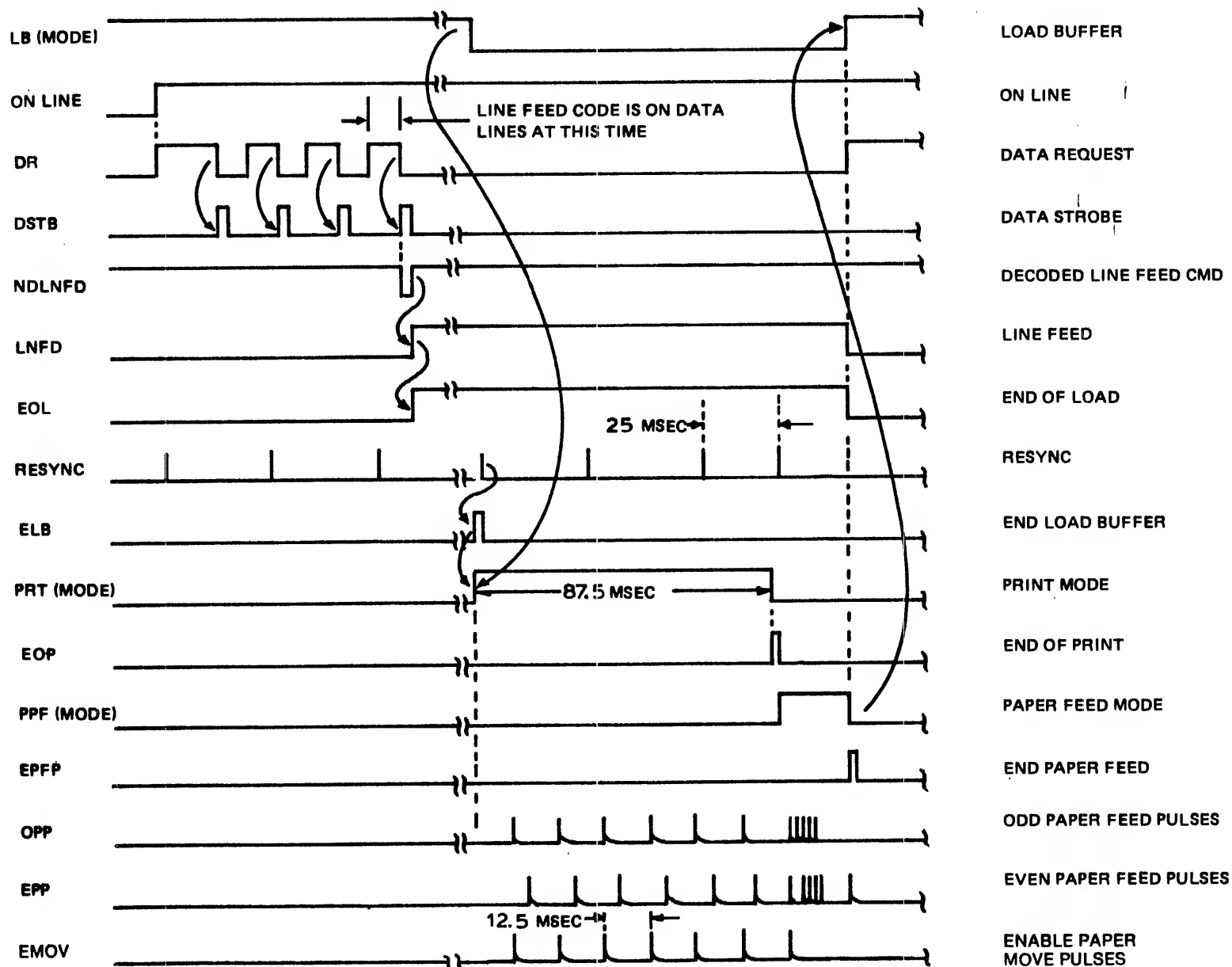
The Load Buffer state is terminated by either of the following:

- a. An entire line of data (up to 132 characters of spaces) has been loaded. The Print state is subsequently entered.
- b. The line of data contains function codes and no printable characters. The Paper Feed state is subsequently entered.

When the printer is Ready (no fault condition) and On Line, the signal EDT becomes true, causing the Data Request signal (IDR or IACK) to become true (**Figure 4**).

As IDR is set, it informs the controller that the printer is able to receive a data character. The controller responds by loading data on the data lines, followed by a Data Strobe pulse (IDSTB), which latches the character into the printer and resets DR.

Figure 3 P600 Printer Overall Timing



NOTE: PAPER FEED PULSES ARE CONTROLLED BY PROM OUTPUT FUNCTIONS AS WELL AS LOGIC GATING. APPROXIMATE REP RATE IS 1000 IMPULSES PER SEC.

Figure 4 Interface Logic—Functional Block Diagram

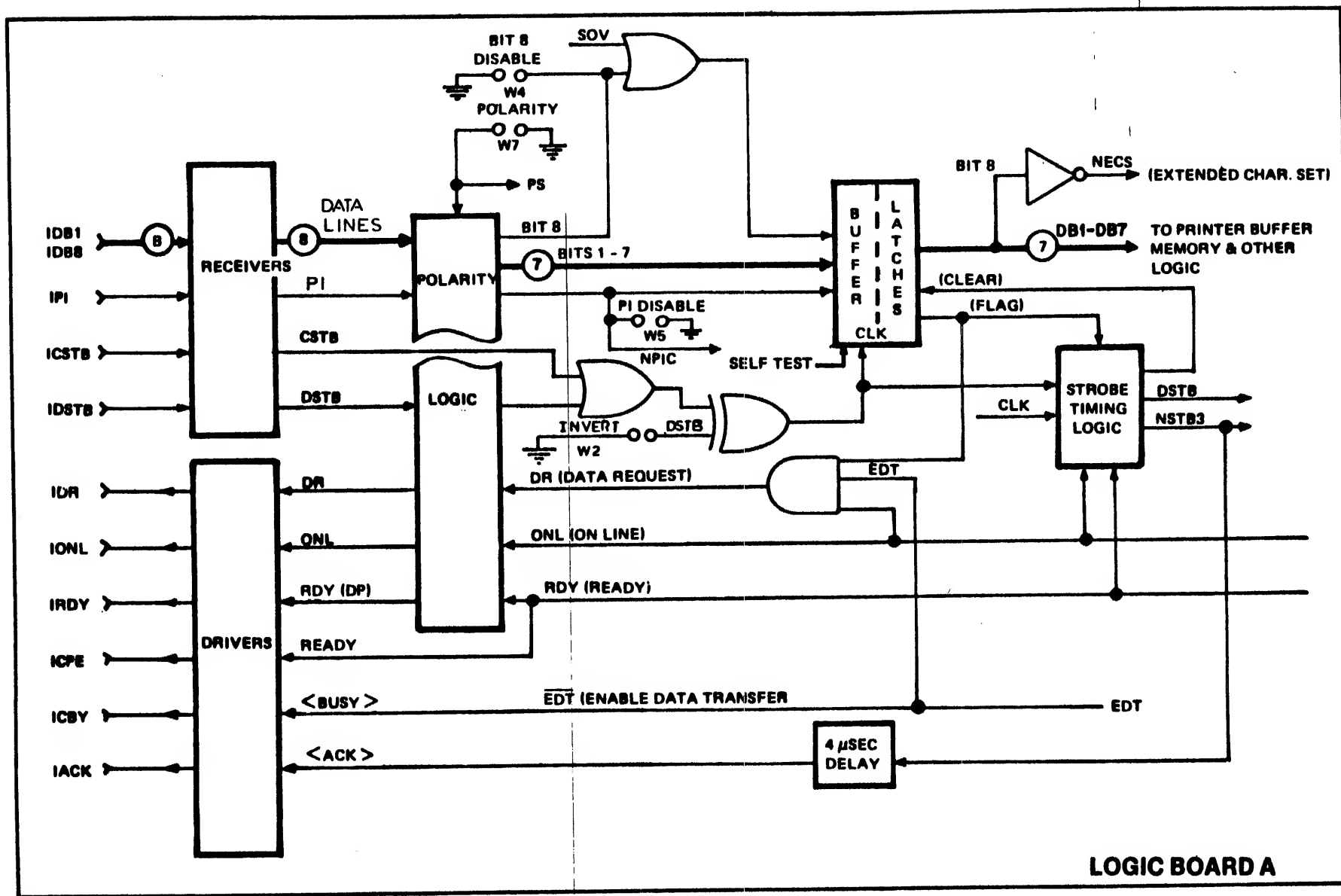
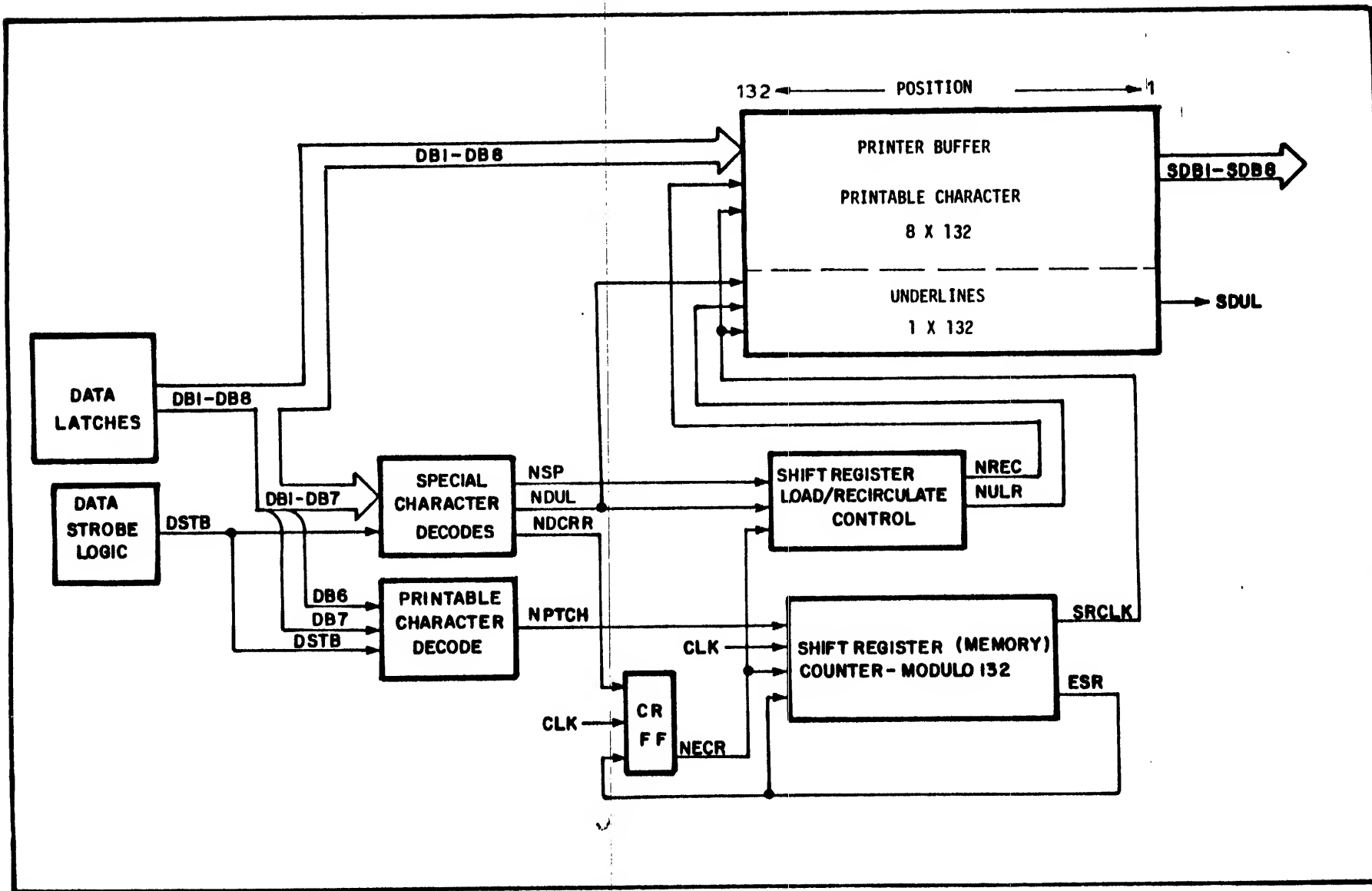


TABLE 2 - Interface Signals

Signal	Description
<u>Received from Controller</u>	
IDB1 - IDB8	<p>Seven-bit character or control code, with bit 8 used to select optional character set (performing the same function as the Shift Out code SOV). If bit 8 is not to be used, jumper W4 in location 8K must be present to disable the bit.</p> <p>Bits 1 through 7 pass through receivers and polarity logic to latches for storage until transfer to the printer buffer.</p>
IPI	Paper Instruction. Asserted by a Dataproducts-type controller when the code on the data lines is to control the VFU and is not to be loaded into the printer buffer. Pi is applied through polarity logic and stored in a latch along with the code on the data lines. If PI is not to be used, jumper W5 in location 8K must be present to disable the line.
ICSTB	<p>Data strobe generated by Centronics-type controller.</p> <p>ICSTB is received and applied to strobe timing logic and to latch circuits which are loaded by the leading edge of the pulse.</p>
IDSTB	<p>Data strobe generated by Dataproducts-type controller.</p> <p>IDSTB is received and applied through polarity logic to strobe timing circuits, and to latch circuits which are loaded by the leading edge of the pulse. Data, function codes, and the PI bit are loaded by DSTB.</p>
<u>Sent to Controller</u>	
IDR	Data Request signal sent to Dataproducts-type controller when IONL is true, printer is in Load Buffer mode, and input latches have been cleared and are ready to accept the next character.
IONL	On Line signal set when operator presses ON LINE pushbutton to make printer able to accept data. Sent through polarity logic and a driver circuit.
IRDY	Ready (RDY) signal sent when ON LINE has not been set but printer is otherwise ready to receive data. RDY is sent through polarity logic and a driver circuit to the IRDY line. RDY also appears on the ICPE line (bypassing polarity logic) for use by a Centronics-type controller.
ICPE	Same as IRDY, but conditioned for a Centronics-type controller.
ICBY	Busy. Indicates to the controller that the printer buffer is not available to receive data.
IACK	Acknowledge. Sent to a Centronics-type controller, through a driver circuit, to request the next character. Set when TCBY is negated or when on-line switch is initiated.

Figure 5 Buffer Memory Load Logic Functional Block Diagram



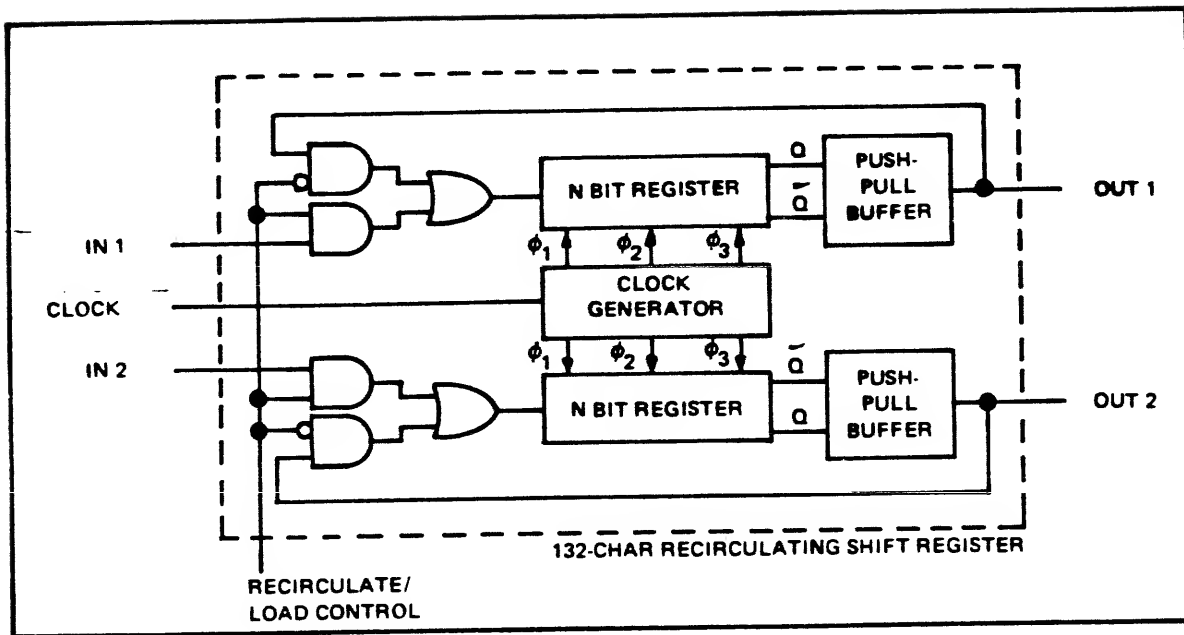


Figure 6 Printer Buffer Shift Register Block Diagram

Data Strobe clocks the latched data byte onto the data lines, into decode registers where it is evaluated. Also, a printable character is transferred into the printer buffer by the internally generated pulse DSTB. DSTB provides a "time window" during which the byte is evaluated and classified into one of four categories:

- a. A printable character including space and underline. A printable character is identified by the term NPTCH whenever these conditions exist together:
 1. Either bit 6 or 7 or both bits of the character is true.
 2. The data strobe IDSTB has been received.
 3. The EVFU control signal PI is false.
- b. Paper motion commands Line Feed (NDLNFD), Form Feed (NDFMFD), and Vertical Tab (NDVT), as well as EVFU commands. Any of these commands terminate the Load Buffer state.
- c. Special characters which are not printable and do not initiate paper motion. **Table 3** defines all special commands and paper motion commands.
- d. Unassigned (empty) codes which have no function and which have no effect in the printer.

Approximately 1.5 microseconds after IDSTB is received, processing of the character is complete. The Data Request (IDR) line again becomes true to request the next character. This loading cycle is repeated until either:

- a. A paper motion command (NDLNFD or NDFMFD) is received and decoded, or
- b. 132 printable characters are loaded into the buffer.

TABLE 3 - Function Codes

Code	Function	Octal	Hex
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> DB7 ↙ DB1 ↘ </div> <div style="display: flex; justify-content: space-between;"> 0 000 100 Half Dot Plot (HDP) 004 04 </div> <div style="display: flex; justify-content: space-between;"> 0 000 101 Plot Mode (PM) 005 05 </div> <div style="display: flex; justify-content: space-between;"> 0 000 110 8 Lines per Inch (ND8LPI) 006 06 </div> <div style="display: flex; justify-content: space-between;"> 0 001 000 Elongated Character (NDEL C) 010 08 </div> <div style="display: flex; justify-content: space-between;"> 0 001 010 Line Feed (NDLNFD) 012 0A </div> <div style="display: flex; justify-content: space-between;"> 0 001 011 Vertical Tab (NDVT) 013 0B </div> <div style="display: flex; justify-content: space-between;"> 0 001 100 Form Feed (NDFMFD) 014 0C </div> <div style="display: flex; justify-content: space-between;"> 0 001 101 Carriage Return (NDCRR) 015 0D </div> <div style="display: flex; justify-content: space-between;"> 0 001 110 Shift Out (SOV) 016 0E </div> <div style="display: flex; justify-content: space-between;"> 0 001 111 Shift In 017 0F </div> <div style="display: flex; justify-content: space-between;"> PI 1 101 110 Start EVFU Load (NSTL)* 156 6E </div> <div style="display: flex; justify-content: space-between;"> 0 011 110 Start EVFU Load (NSTL)** 036 1E </div> <div style="display: flex; justify-content: space-between;"> PI 1 101 111 End EVFU Load (NELD)* 157 6F </div> <div style="display: flex; justify-content: space-between;"> 0 011 111 End EVFU Load (NELD)** 037 1F </div> <div style="display: flex; justify-content: space-between;"> 1 011 111 Underline (NDUL) 137 5F </div> <div style="display: flex; justify-content: space-between;"> 1 111 111 Delete (DEL) 177 7F </div>			
<p>*Jumper W5 omitted from Logic Board A.</p> <p>**Jumper W5 present on Logic Board A.</p>			

Figure 7 shows relative timing of the DR, IDSTB, and DSTB signals.

As each printable character is clocked into the printer buffer (by SRCLK), the shift register counter is incremented by one. When either NDLNFD or NDFMFD is received and decoded, this ends the input line. NPAADV (Paper Advance Command) becomes true and generates NEOL (End of Load). NEOL transitions EDT (Enable Data Transfer) false which:

- a. Holds DR (Data Request) false, inhibiting further data transfers to the printer.
- b. Transitions ICBY (Interface Control Busy) true, informing the interface of the printers busy status.

After the paper motion command is decoded and further input stopped, the counter begins to count clock pulses to a count of 132. At count 132 End Shift Register (ESR) comes true, raising End Load Buffer (ELB). ELB sets the Print mode flip-flop to end the Load Buffer operation.

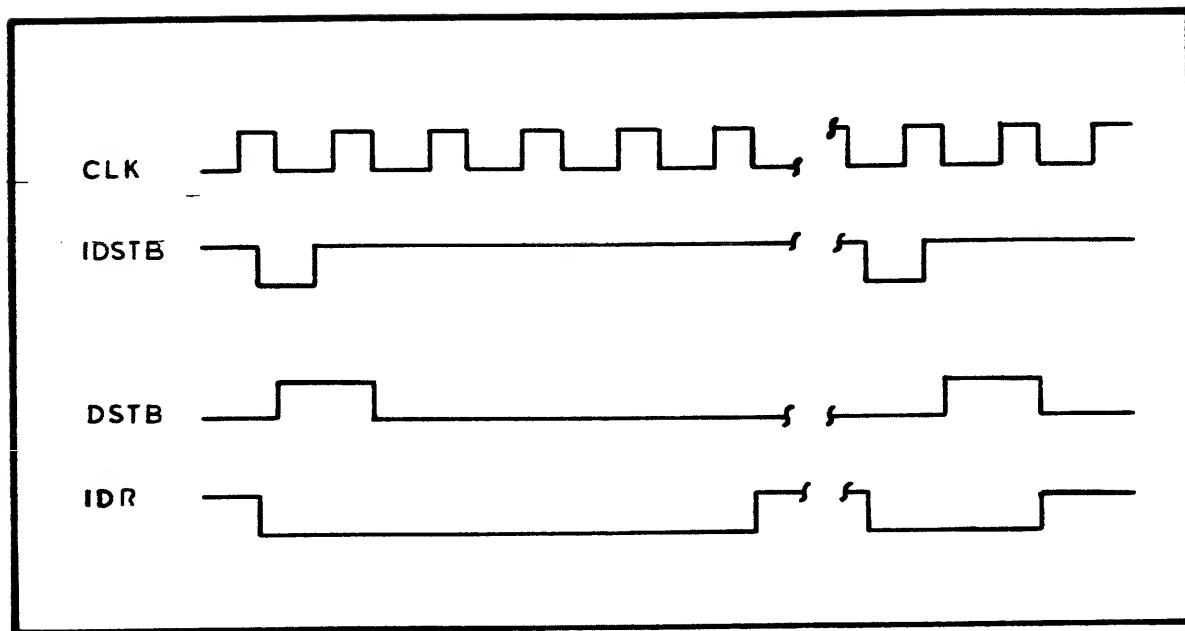


Figure 7 Data Strobe and Data Request Timing

The term NREC normally is false during loading. It becomes true to enable data in the printer buffer to be recirculated when a Carriage Return (CR) code is received prior to either:

- a. A Space character – the buffer is recirculated only one character location.
- b. An Underline code – the Underline bit is loaded into its own shift register as the associated character is recirculated.

If the line of data consists only of a paper motion command, no NPTCH signal is generated for that line and the term NPC steers the ELB signal so that the Paper Feed flip-flop (PPF) is set, instead of the Print flip-flop (PRT.).

2.4 PRINT STATE OPERATION

In the print state of operation a line of characters is printed, dot row by dot row, as the shuttle makes back and forth scans. Sixty-six hammers are each activated to print dot patterns on the paper that correspond to those addressed in the Character PROMS.

The print state is entered (the PRT flip-flop is set) when all of the following conditions are satisfied:

- a. The printer is in the Load Buffer state (LB), and the printer buffer contains printable characters which may include spaces and underlines (PC is true).
- b. A paper motion command (NDLNFD or NDFMFD) has been decoded, ending the input line (EOL is true).

- c. Data has been shifted to the output end of the printer buffer (left-justified, ESR true).
- d. The shuttle has come up to normal speed (SUS true).
- e. A RESYNC pulse occurs (the shuttle is at the left hand end of its back and forth cycle).

The print state is ended and the Paper Feed state is entered when the last dot row of the character line has been printed (EOP is true). Note that, although paper is advanced by dot rows during the Print state, the Paper Feed state is not entered until the last row has been printed.

Figure 8 shows the principal logic elements involved in Print state operations.

2.5 PRINT SYNCHRONIZATION

Print hammer activation is synchronized with shuttle movement by means of signals obtained from the magnetic pickup. The magnetic pickup (MPU) is next to the timing disk mounted on the rear of the shuttle drive flywheel. The timing disk is oriented so that timing signals relate precisely to the shuttle position. The MPU senses variations in magnetic reluctance from 140 apertures near the perimeter of the timing disk. The apertures are sensed by the magnetic pickup as the disk rotates (**Figure 9**). Two of the apertures are of double width and separate the remaining 138 single-width apertures into two groups of 69. These wider apertures generate a RESYNC signal. Their location relative to the double lobed cam make RESYNC occur each time the shuttle begins its movement to the right.

The 138 single width apertures generate 138 SYNC pulses. Full rotation of the disk provides four 8.57 millisecond printing periods which control printing during two back and forth shuttle cycles. Each printing period is followed by a 3.9 millisecond "turnaround" period during which the direction of shuttle movement is reversed and no printing occurs. During the turnaround period, paper is advanced (0.0139 inch) to the next dot row.

During each of the four 8.57 millisecond printing periods, an entire 24 column dot row is printed with each of 66 hammers printing all dots for two characters. Each character position comprises 12 dot columns (nine for the character and three for intercharacter spacing) and requires 12 SYNC pulses. Therefore, a total of 24 (2 x 12) SYNC periods are required as each dot row is printed.

The resulting 0.5 millisecond SYNC signal is distributed to other printer logic including detection logic for the double width aperture ("missing pulse") in the timing disk. The resulting 0.5 millisecond RESYNC pulse synchronizes printer logic with the beginning of each left to right shuttle transition.

The SYNC signal synchronized with the printer clock performs the following functions:

- a. Initiates a high speed scan of all 132 character locations in the printer buffer during which each character is presented to character generation logic.
- b. Causes the activation of all hammers armed with logic "1's" during the previous scan of the printer buffer.

Figure 8 Print State Operation Functional Block Diagram

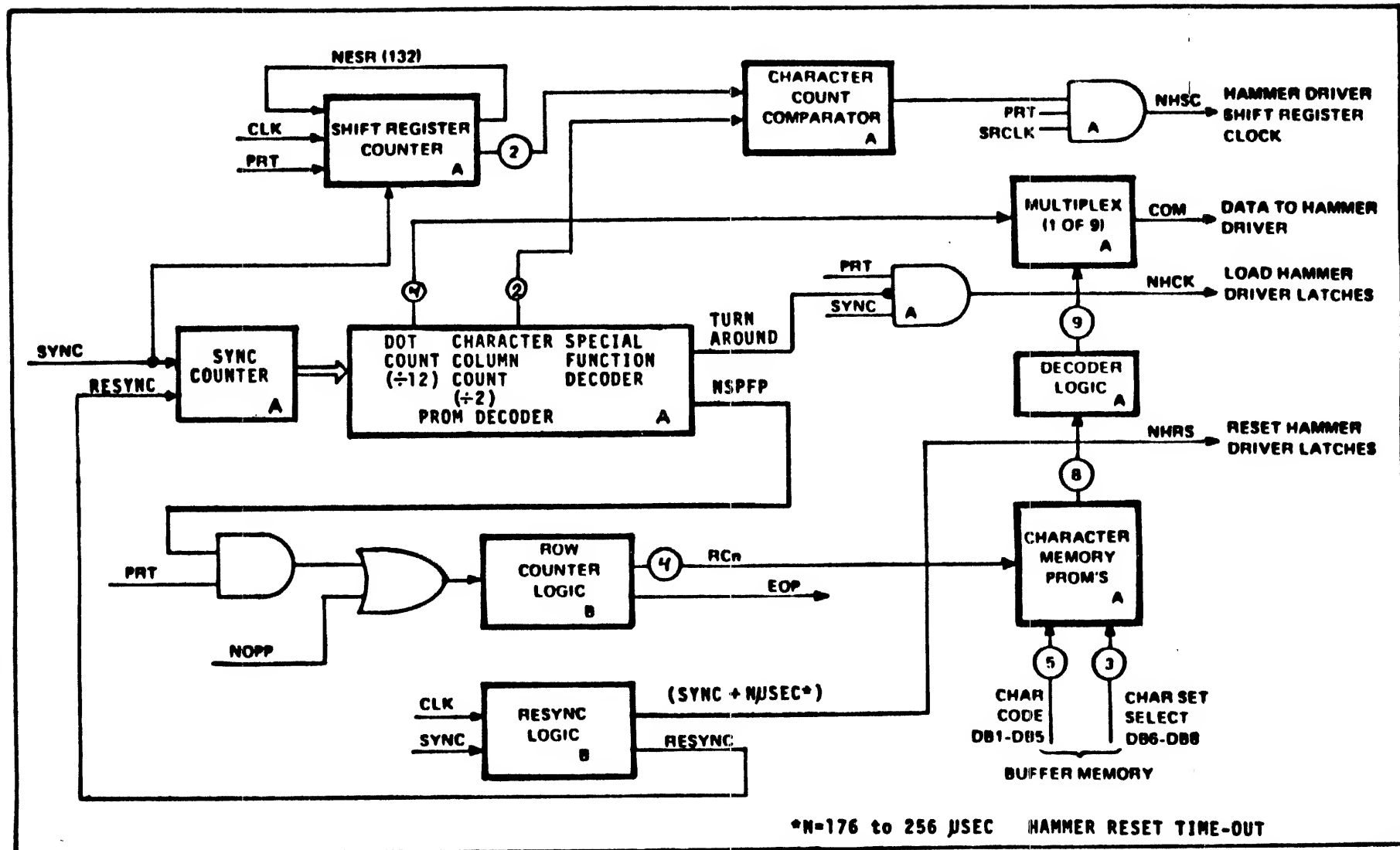
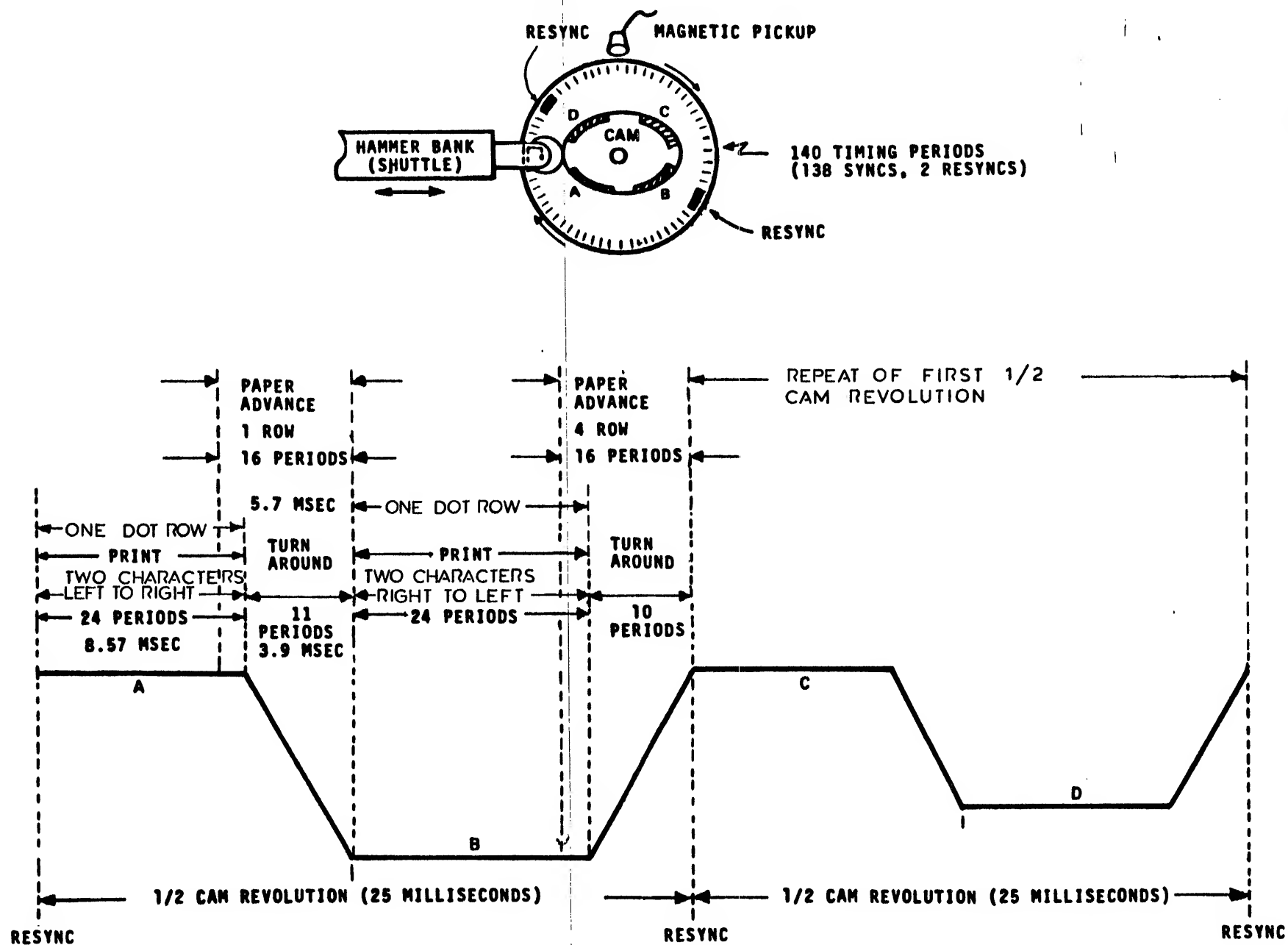


Figure 9 Dot Row Timing VS. the Timing Disk and Cam Position



- c. Initiates a time out period (between 176 and 256 millisecond) which controls generation of the Hammer Reset (NHRS) signal. This signal resets hammer driver circuits previously activated by SYNC for the prior dot location. Refer to subsection 2.23.
- d. Causes the Dot Column and Character Column counters to be updated. These counters, described in succeeding subsections, determine which hammers are activated during each SYNC period and for which dot row.

Figure 10 further illustrates timing of SYNC and RESYNC signals. The roughly sinusoidal output of the magnetic pickup is amplified and converted to a TTL compatible square pulse by a circuit on the Power Supply PCBA. The resulting MPU signal is logically synchronized with the printer clock (CLK).

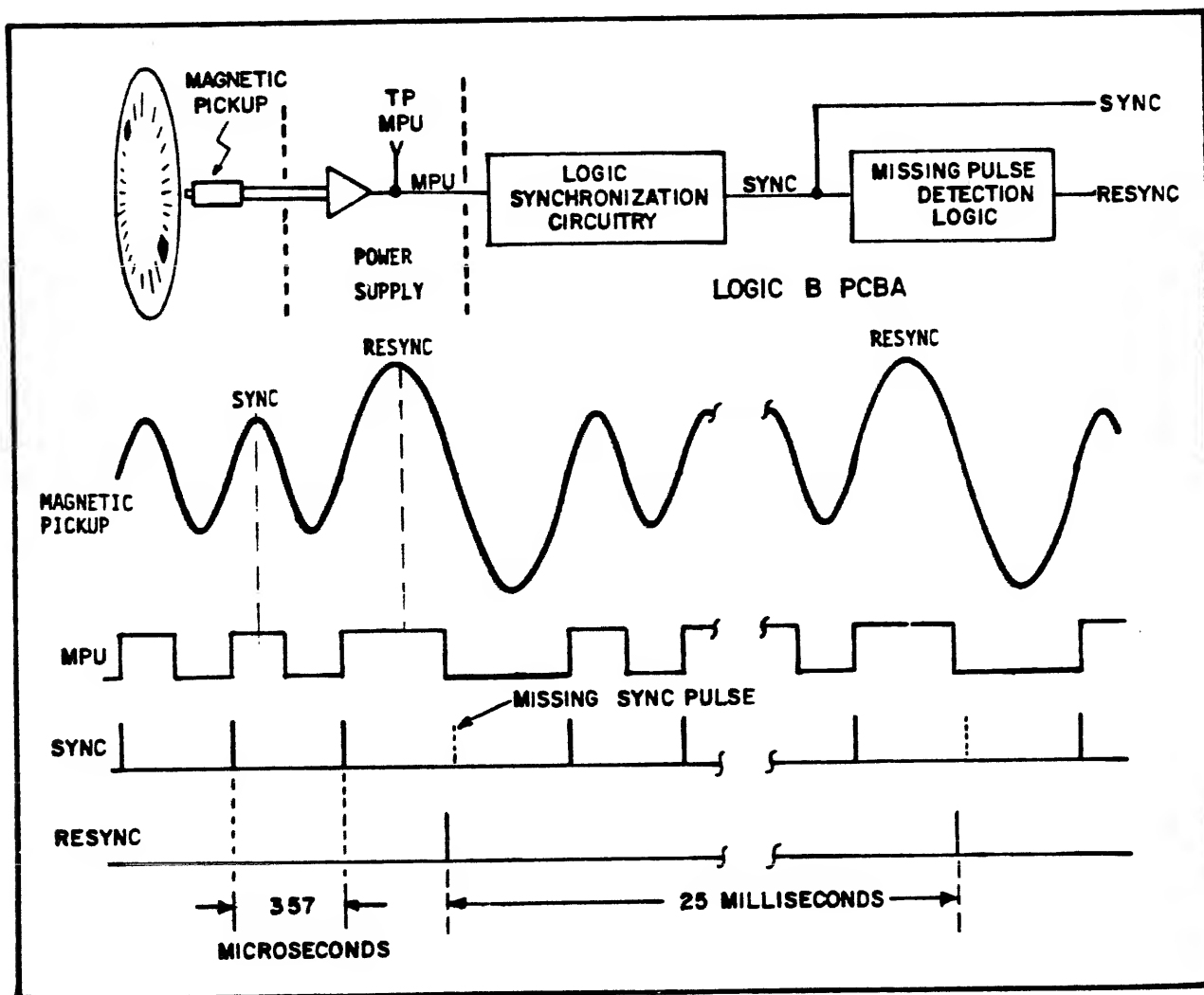


Figure 10 Operation of SYNC and RESYNC

2.6 DOT SELECTION LOGIC

The following subsections describe the operation of this logic as it selects the hammers which are to be activated during each SYNC period, for a given dot row. **Figure 11** is the block diagram of the logic. Individual portions of the logic are presented in turn, along with timing diagrams.

Each hammer can print only one dot at a time. Each character is formed in a 9 x 7 dot matrix (or 9 x 9 for lower case characters with descenders). Therefore, for each dot period (24 during each one way shuttle scan) the logic must address a specific dot column and dot row within the matrix. Further, because each hammer prints two adjacent characters the logic must determine whether the shuttle is positioned to print the odd numbered characters or the even numbered characters.

2.7 THE CHARACTER DOT MATRIX

The character is presented within a 12 x 12 matrix (**Figure 12**). At a line spacing of six lines per inch, there are 12 dot rows from the top of one character line to the top of the next.

Of the 12 possible dot columns, nine are used for the character and three are used for intercharacter spacing.

A vertically elongated character (**Figure 13**) may be printed, instead of the standard seven row character. The elongated character is generated by printing each dot row, except the first and last, twice. Consequently, an elongated character is made up of 13 dot rows instead of seven. (For lower case character with a descender, 16 rows are printed instead of nine. The first and last dot rows are printed only once in this case also.)

The printer can print only six of the twelve possible dot columns in any character dot row (**Figure 14**). This is because the P600 cannot print dots in the two successive dot columns within the same dot row, except in Plot Mode.

In Plot Mode operation, each received character line data code message defines information to be printed in a single dot row, instead of a line of multi-row characters. That is, each dot row is defined by the data message.

An upper case character occupies seven horizontal dot rows, with five rows remaining for interline spacing.

A lower case character occupies nine horizontal dot rows, with three rows remaining for interline spacing. Underlines are printed in the ninth row only.

When the operator (or the program) selects line spacing of 8 LPI, the character line interval is reduced from twelve to nine dot rows.

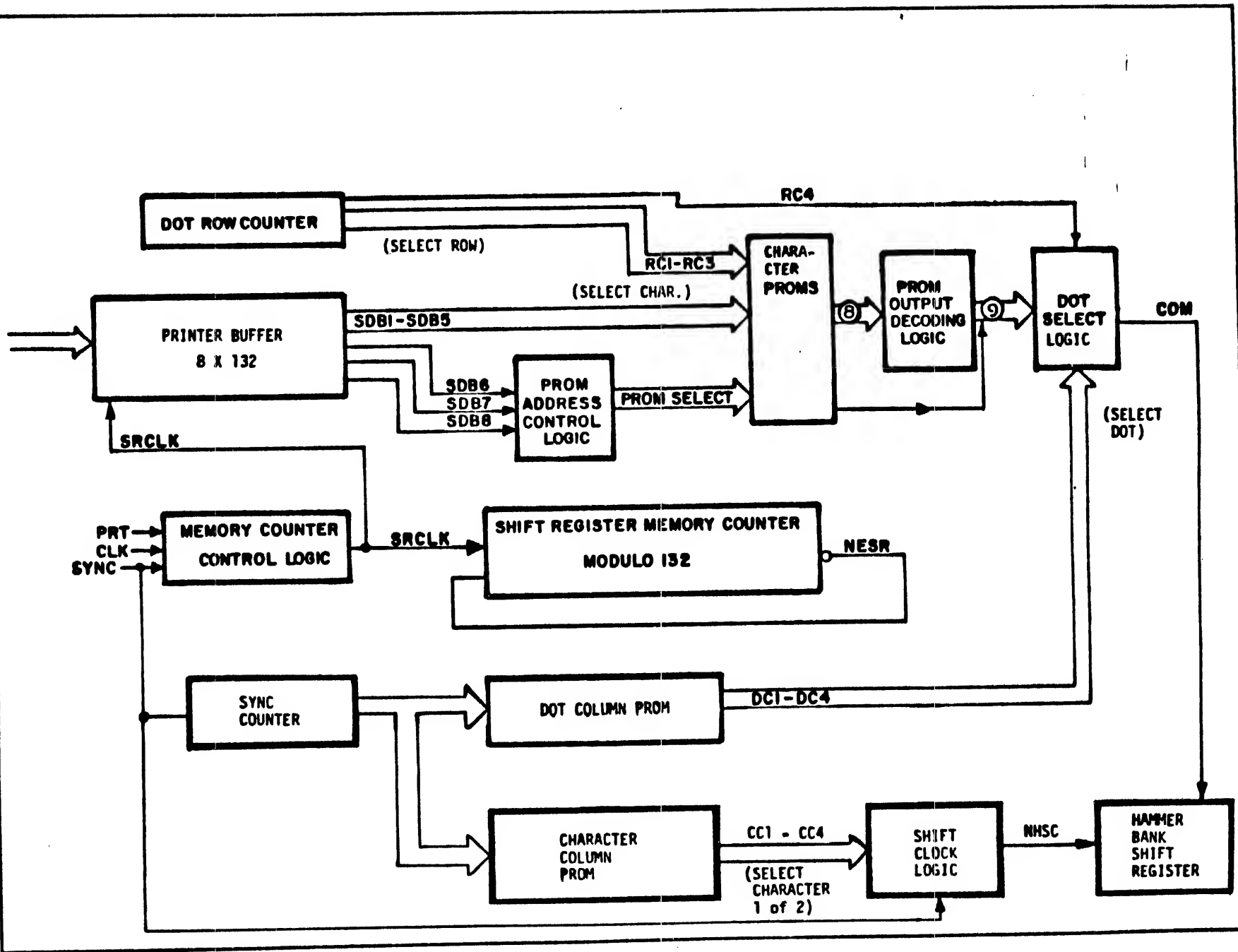


Figure 11 Dot Selection Block Diagram

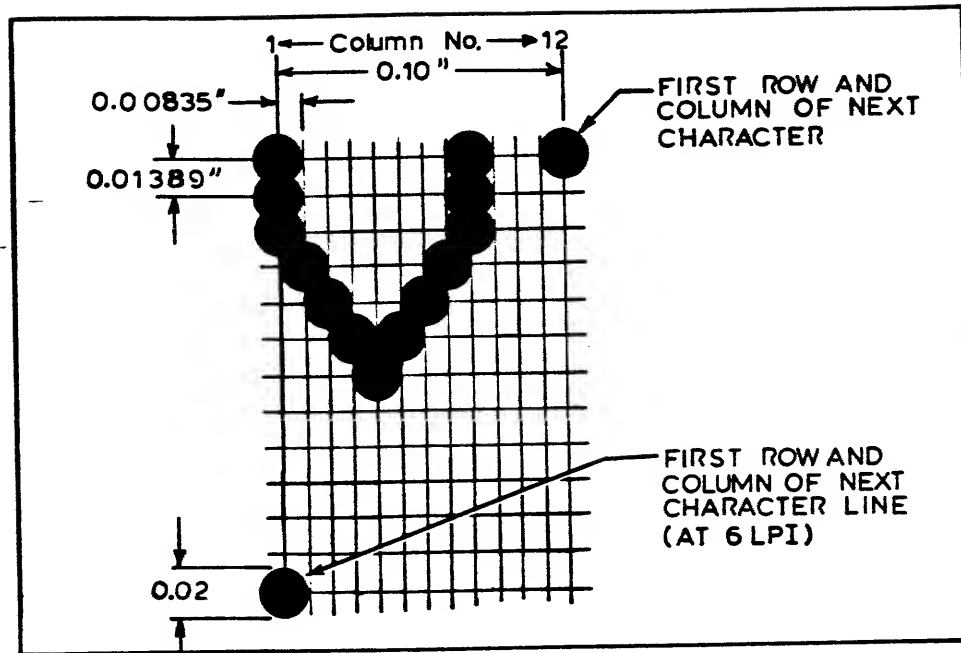


Figure 12 Dot Matrix Specifications

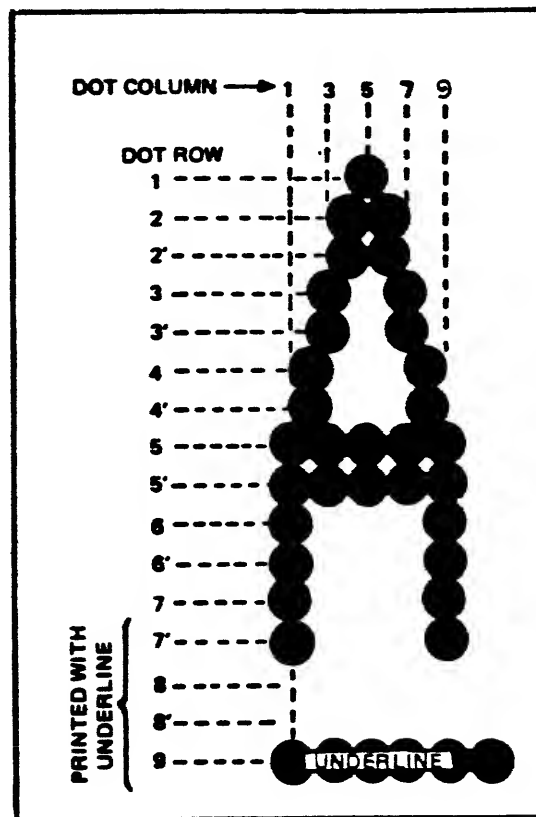


Figure 13 Typical Elongated Character

2.8 CHARACTER GENERATION

In order to understand the purpose and effect of dot selection logic, it is necessary to understand the method of generating the dot stream derived from the character codes received at the interface.

The standard character memory comprises two, four, or six 256 x 4 PROM devices, depending on the character set (32, 64, or 96 characters). The PROMs, on the Logic A PCBA, act in pairs. Each PROM in a pair contains half the dot columns of the 32 characters stored in that pair, and each pair provides eight outputs for the addressed dots. The ninth output is supplied by decode logic fed by the PROM outputs and RC4.

Normally, PROMs in locations 1K and 2K store numeric characters (ASCII characters 1-32) and those in locations 1H and 2H store alphabetic characters (ASCII characters 33-64) of the upper case ASCII set.

ASCII lower case characters are stored in a PROM pair in locations 1F and 2F (ASCII characters 65-96). Other optional sets may be installed in locations 1E and 2E (ASCII characters 96-128) and 1D and 2D (ASCII characters 129-160). The optional extra width character set may be used along with the lower case set without modification.

Figure 15 illustrates character Prom addressing. Character PROM pairs are selected by bits SDB6, SDB7, SDB8 as the contents of the printer buffer are recirculated and presented to all PROMs. The contents of each PROM pair are addressed by bits SDB1 through SDB5.

Return to Figure 11; the dot matrix for any character is stored in a PROM pair in terms of rows and columns. The matrix for an addressed character is readout one row at a time by the binary row count RC1 through RC3. Because a dot may appear in any of nine dot matrix columns (although none adjacent) and the PROMs provide only eight outputs, the encoded PROM outlets are decoded and supplied along with row count bit RC4 to dot selection logic to provide nine lines. Bits on the nine lines are multiplexed, one line at a time, onto the COM line under control of the dot column counter output (DC1-DC4). COM is then clocked into the hammer driver logic.

During any SYNC period, information appearing at the hammer driver logic consists of a "1" bit (dot) or a "0" bit (no dot) in a specific dot column of a specific row for every character read from the printer buffer. However, only every second bit (representing every other dot location) in the COM data stream is clocked into the hammer driver shift register so that the 66 (132/2) hammer driver circuits may be driven.

At the beginning of a left-to-right shuttle scan, the COM line receives a bit for dot column 1 of each odd numbered character. This is followed by a bit for each subsequent dot column of each odd numbered character. Then, the COM line receives dot information in the same dot column order for all even numbered characters.

During a right-to-left shuttle scan, dot information is put on the COM line in reverse order, starting with dot column 12 of all even numbered characters and ending with dot column 1 of all odd numbered characters.

Summarizing the dot selection process, a dot is selected for printing in five simultaneous steps, as the contents of the printer buffer are recirculated and presented, one character at a time, to the character PROMs. These steps are as follows:

- a. Bits SDB6 through SDB8 select the PROM pair.
- b. Bits SDB1 through SDB5 address a specific character within that PROM pair.
- c. The row count (RC1-RC4) selects one row of dots from the selected character.
- d. The column count (DC1-DC4) selects a single dot from the selected dot row to generate the COM data (dot) stream.
- e. The character column count selects alternate bits from the 132-bit COM data stream to be clocked into the 66-hammer driver shift register.

2.9 DOT COLUMN COUNTER AND CHARACTER COLUMN COUNTER LOGIC

This logic (**Figure 16**) provides signals to multiplex the character dot pattern from a PROM address to the hammer bank shift register. The PROM address is defined by the character generator decode. Correlation of dot locations within the dot pattern is maintained during the transfer.

Return to **Figure 11**; a dot column count (DC1-DC4) defines each of the 12 dot columns that comprise a character space in the character line. For a given dot row, all print hammers are simultaneously positioned to print a dot in the same dot column of either all odd numbered or even numbered characters. The dot column count multiplexes outputs of the character generator decoder to the COM line. During any SYNC period of a print cycle, the hammer driver shift register contains dot information for a specific one of the 12 dot columns. (Printing actually may occur in only one of nine of the 12 dot columns).

During each SYNC period the dot column count selects one dot location from each of the 132 characters (or character spaces) recirculated through the printer buffer and delivers it to the COM line.

On the shuttle stroke from left-to-right, the hammer driver shift register is clocked 66 times during each of 12 SYNC periods to load and print dot information for every odd numbered character. It is then clocked 66 times during the next 12 SYNC periods to load and print dot information for every even numbered character. In all, 132 bits of information are loaded and printed.

On the shuttle stroke from right-to-left, operation is the same except dots are printed first for all even numbered characters and then for all odd numbered characters starting with dot column 12 instead of dot column 1.

Figure 16 shows logic that provides the dot column and character column counts. **Figure 17** illustrates the correlation between the various counts and the formation of the character.

In **Figure 15**, the SYNC counter is cleared by RESYNC as the timing disk begins each half of its rotation. Note that each half-revolution of the disk provides timing for one back-and-forth cycle of the shuttle (two dot rows).

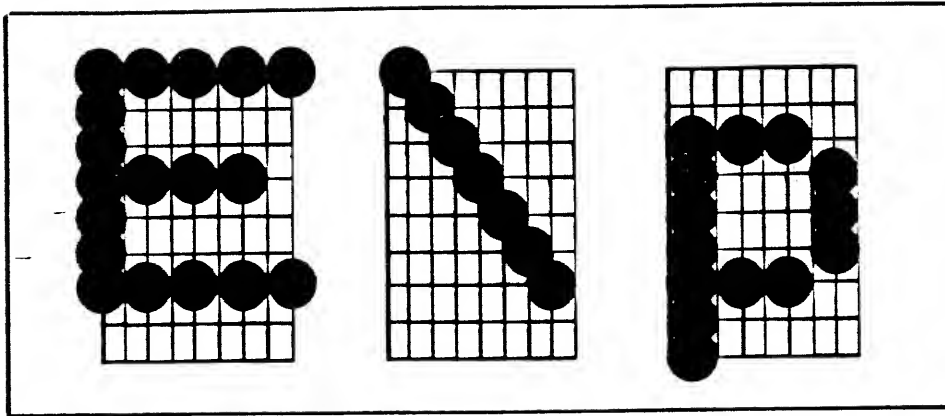


Figure 14 Typical Elongated Characters

As subsequent SYNC pulses are generated by timing disk rotation and the shuttle travels from left-to-right and then from right-to-left, outputs of the SYNC counter appear at three PROM devices. One device decodes counts to provide the dot column count (DC1-DC4), the second decodes counts for the character column count, and the third decodes various counts which generate control signals NSPT, NSPFP, and NEMOV.

The Dot Column Count PROM encodes a binary count at a count of 12 SYNC pulses (defining the left-hand character), a count of 12 additional SYNC Pulses (defining the right-hand character), and then an additional count of 11 pulses to time out the shuttle turnaround at the right-hand end of its cycle. Then, as the shuttle moves towards its left-hand position, two additional counts of 12 are encoded to define the right-hand, then the left-hand, character. Finally, a count of 10 SYNC pulses times out the turnaround at the left-hand end of shuttle travel which is the end of the shuttle cycle.

The Character Column Count PROM encodes the character column binary count and the turnaround signal TAI. The binary count is used to enable generation of hammer shift clock pulses (NHSC) only during the 24 SYNC periods of each shuttle stroke that dot row information may be printed.

Hammer Shift Clock Counter logic is a count of two counter rest by SYNC. Its outputs appear at a comparator which asserts its "equals" output only when:

- a. An odd numbered character is read from the printer buffer and the bits CC1-CC2 are encoded 01.
- b. An even numbered character is read and CC1-CC2 is encoded 10.

Consequently, the hammer bank shift register is clocked by NHSC (gated SRCLK pulses) to load it with data correlated for only odd numbered characters, or only even numbered characters.

The signal TAI is generated to inhibit any NHSC pulses during turnaround periods. TAI is synchronized with the SYNC and CLKB pulses. This provides the signal NTA which controls the NHSC gate.

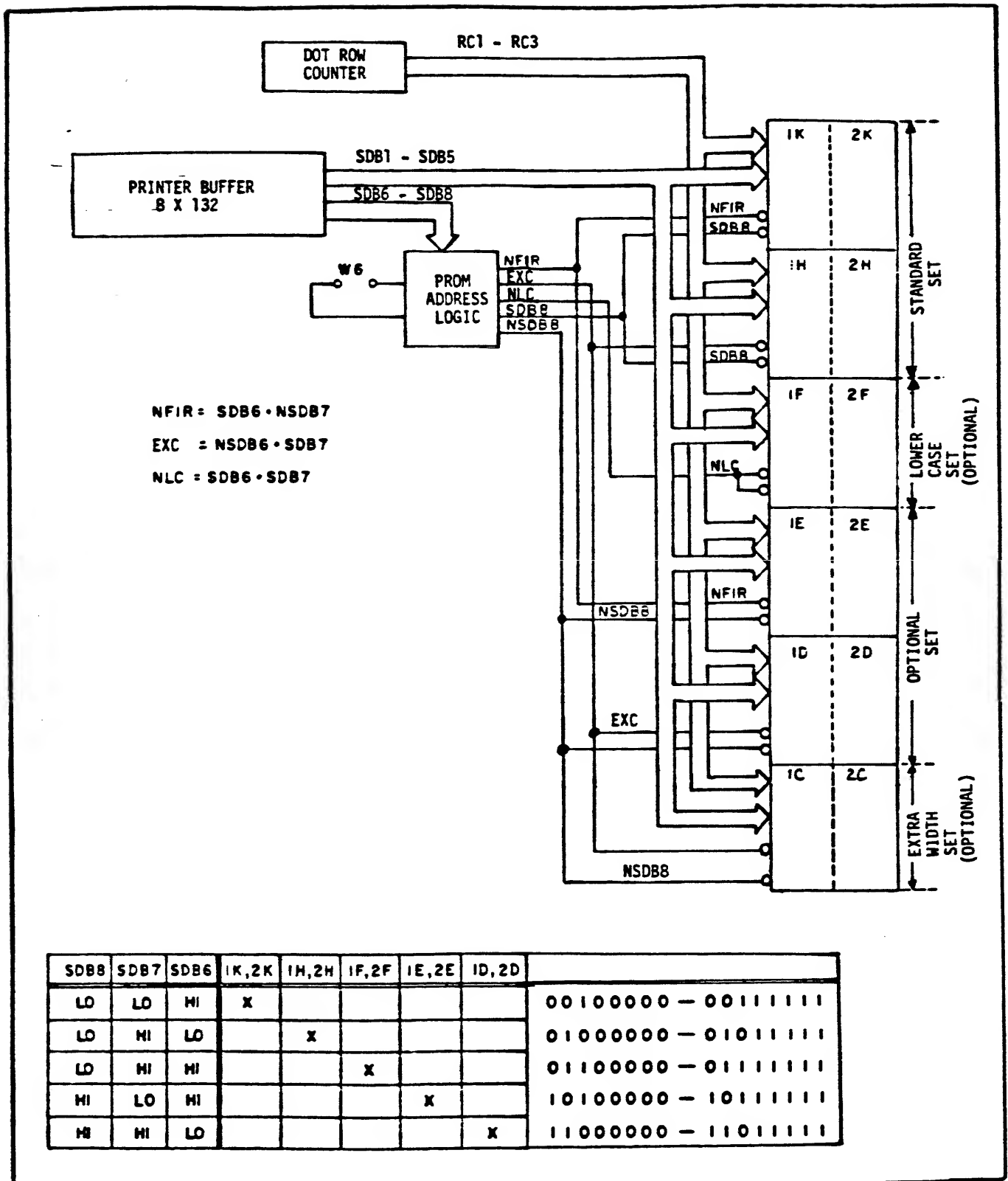


Figure 15 Character PROM Addressing

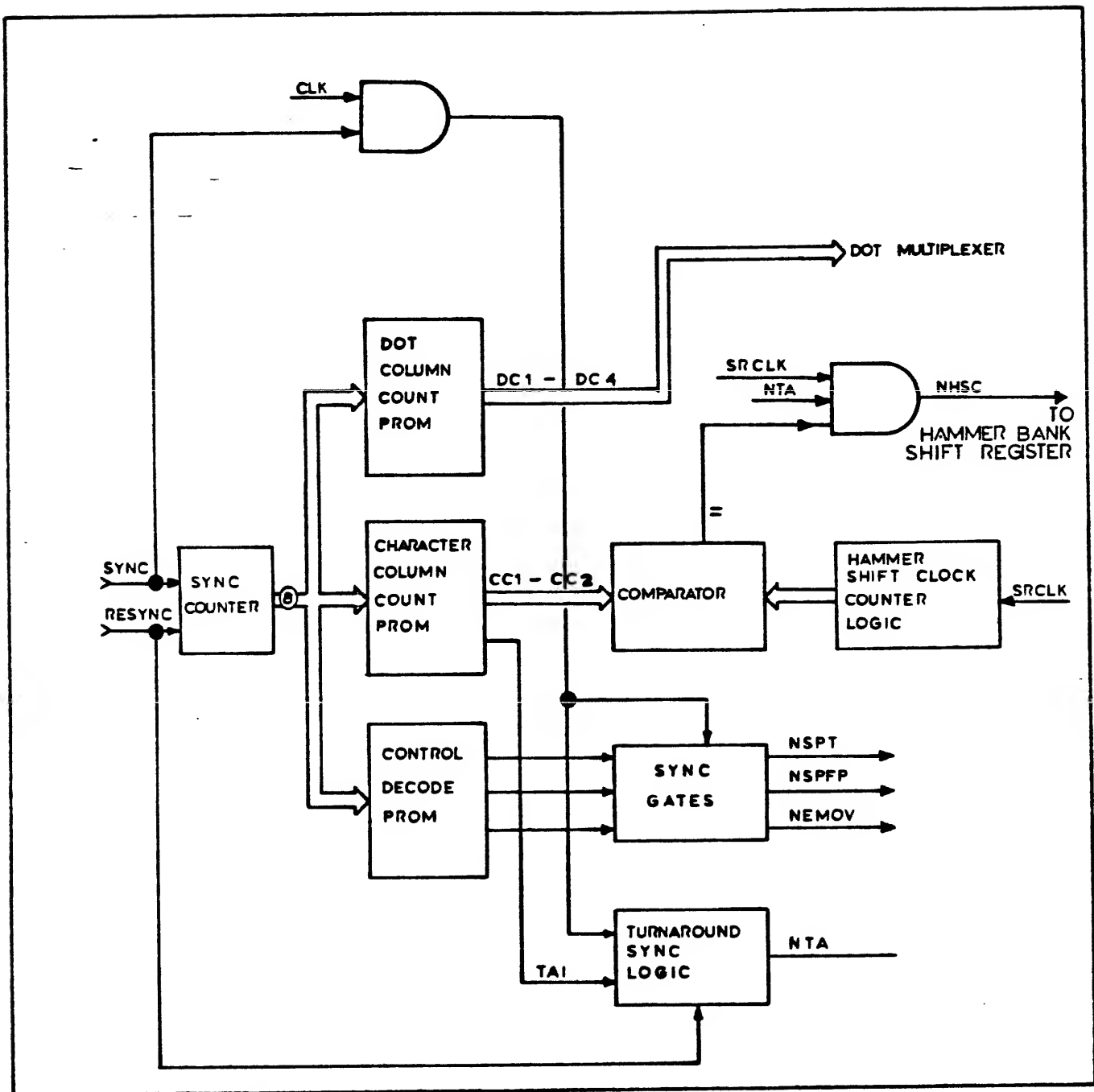


Figure 16 Dot Column and Character Column Counter Logic Block Diagram

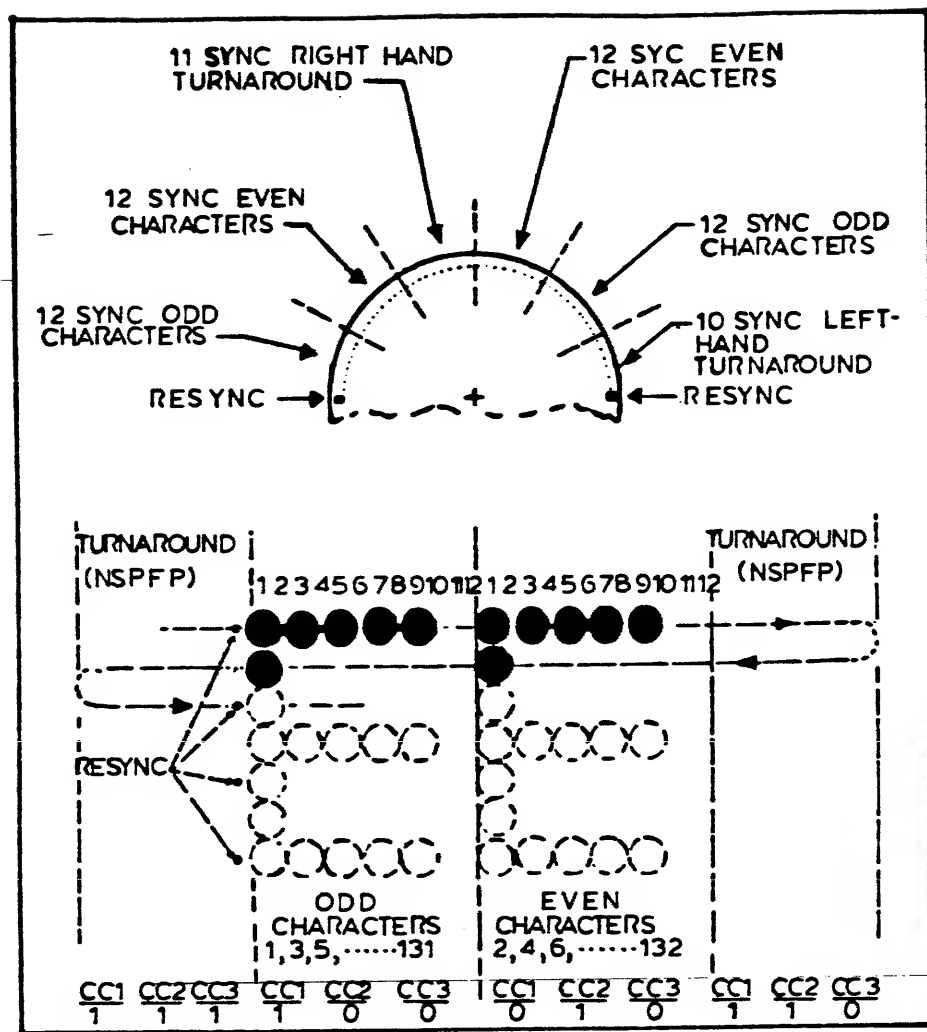
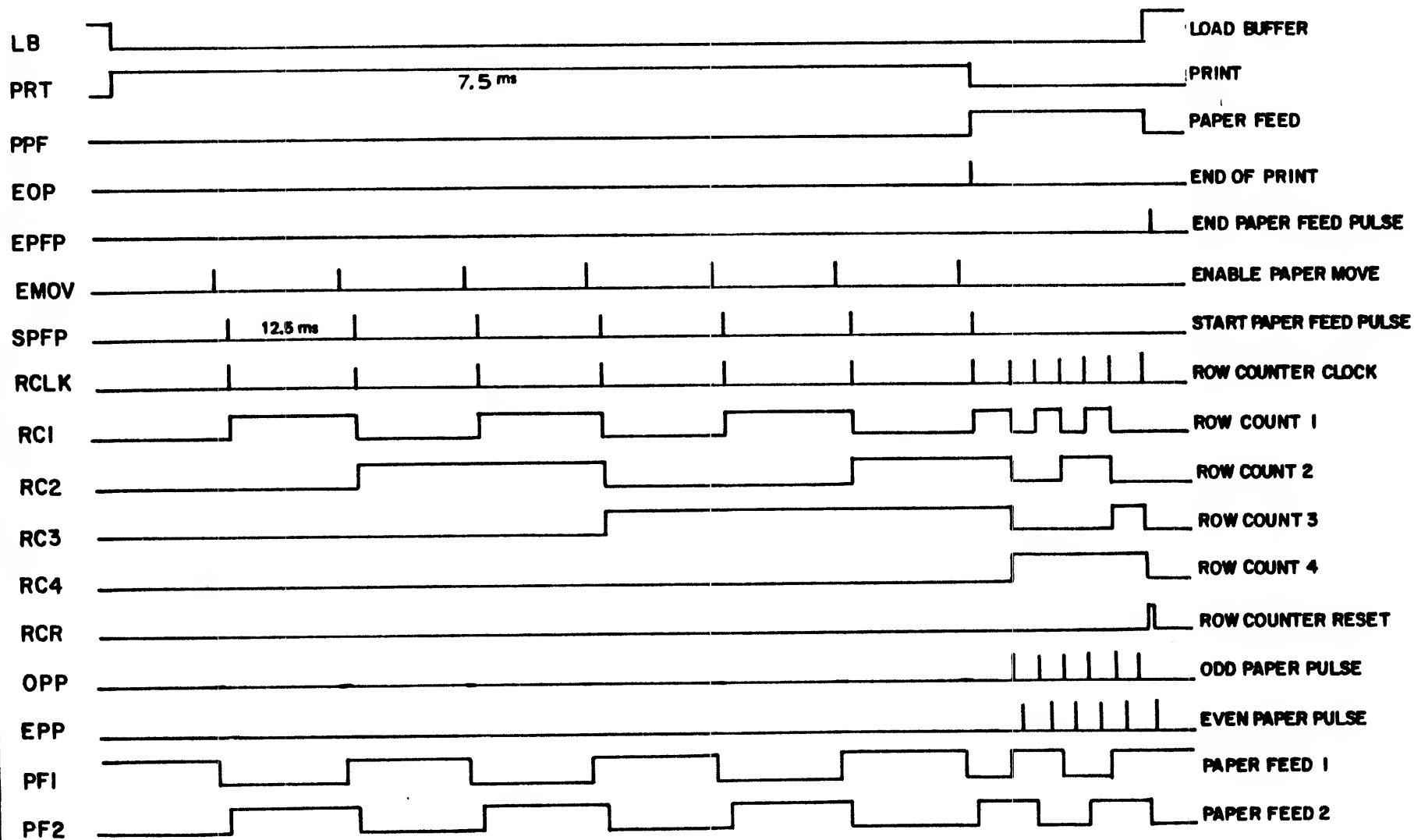


Figure 17 Dot Column and Character Column Counters Timing for One Shuttle Cycle

Figure 18 Row Counter Operation Timing



Three other control signals are generated by the control decode. These are:

- a. NSPT (Start Print) which initiates the Print state in state control logic.
- b. NSFPF (Start Paper Feed Pulse) which increments the dot counter.
- c. NEMOV (Early Move) which occurs five dot columns before shuttle reversal begins (at either end of shuttle travel) and initiates paper movement to the next dot row.

2.10 DOT ROW COUNTER LOGIC

Dot Row Counter logic generates a 4 bit binary count (RC1-RC4). RC1-RC4 appears at the character generator PROMs to select specific rows of dots to be printed. The PROM output defines each row of dots in the character matrix as the character line is printed. The row counter counts the number of rows in the entire character line, including interline space.

When the Print (PRT) state is entered (**Figure 18**), an odd character is read from the buffer and the row counter is incremented by the Start Paper Feed pulses (SPFP).

Row Counter Reset (RCR) resets the row counter at a count of 12 for 6 LPI line spacing, or a count of nine for 8 LPI spacing. The following EVEN Paper Pulse (EPP) resets RCR. The actual character is normally made up of seven dot rows. However, a nine row character is printed if NPAL is true. NPAL is derived from the Underline signal SDUL or from a Print Nine Rows flag from the PROM decoder.

When the last row in the printed character itself has been printed, counter logic provides:

- a. End of Print (EOP) signal which causes the Print state to be terminated.
- b. Paper Feed state to be entered in order to advance paper to the top of the next character line.

EOP also sets the Paper Feed mode (PPF) and the row counter is subsequently clocked by Odd Paper Feed pulses (NOPP).

When an elongated character is to be printed, operation differs in that the decoded Elongated Character Signal (NDEL) causes only every second row counter clock pulse RCLK (SPFP or NOPP) to increment the row counter. Consequently, each row of dots in the character (except the first and last rows) is printed twice, as paper is advanced for each row of the elongated character.

In Plot Mode operation, each line of data specifies dots to be printed in a single dot row without regard to any other dot row. The PM signal (instead of the decoded row count) enables the SPFP pulse to generate End of Print (EOP).

2.11 PLOT MODE OPERATION

Operation in the Plot Mode is essentially the same as when characters are printed except that each line is produced on a single dot row instead of having full character line definition.

In the Plot Mode, data appears only on memory output lines SDB1 through SDB6. A decoded Plot Mode code (005_g), which accompanies the data, causes the signal PM to direct the memory output to the COM line instead of the character PROMs used in text printing. A data bit "1" will cause a dot to be printed.

Dots for each 6-bit code are printed in the even-numbered dot columns, within the 0.1-inch character width. Bit 6 of the code appears at the right-hand side, with bit 1 at the left (**Figure 19**). A 14.94-inch wide form will accommodate 792 dot rows, each comprising 792 (6 x 132) dots.

The Plot Mode command must accompany each line of plot data. After it is stored it is then cleared by the term EPFP when the dot row has been completed.

The signal PM inhibits the underline control SDUL and enables data bits (SDBn) to be multiplexed to the COM line (the input to the hammer bank shift register).

PM also overrides the decoded rows per character count signal EOP (End of Print), so that each line of data is plotted without regard to character line definition. Dot rows per character count signal EOP (End of Print), so that each line of data is plotted without regard to character line definition. Dot rows are advanced at the standard printing rate, but overall paper motion depends on the data source being able to reload the buffer within the stroke time.

In normal plotting, dots are printed only during shuttle movement from left-to-right. However, the plotting rate may be increased by connecting the normally omitted jumper W4 (location 8K on the Logic B PCBA). This jumper causes plotting to occur during both movements of the shuttle cycle.

CAUTION

To avoid damage to the hammer driver circuits, do not connect jumper W4 without first consulting the precautions in the P600 Applications Manual and the plotting application note.

Half dot plotting may be used to print solid lines or areas of greater density, or to obtain improved resolution. In half dot plotting, dots are printed (in a left-to-right shuttle movement) in odd numbered dot columns. Because paper is not advanced for the dot row during half dot plotting, those dots are interspersed with the dots printed in even numbered dot columns in that dot row during normal plot of new data.

Half dot plotting is specified, by the code 004₈. The decoded command (NHDP) inhibits the NOPP pulse from generating a row clock (RCLK) pulse and inhibits paper motion. The half dot code and data must precede any normal Plot Mode code and data, since paper motion occurs only with Plot Mode code functions, even though a line feed code is used for each data transfer termination.

2.12 HAMMER DRIVER PCBA CIRCUITS

There are 66 print hammers, each controlled by an electromagnetic coil, a driver and logic which controls energization of the coil. Each hammer prints dots for two adjacent characters. **Figure 20** illustrates logic and circuits on the Hammer Driver PCBA and **Figure 21** shows timing of these circuits.

Circuits on the Hammer Driver PCBA perform the following functions:

- a. Convert serial "dot" bits on the COM line into parallel bit data.
- b. Control the energizing of hammer coils to print dots in accordance with the parallel bit data.
- c. Provide safety features to prevent energizing coils in the presence of conditions which might damage the coils.
- d. Provide an isolated and regulated +5V DC supply for TTL logic on the Hammer Driver PCBA.

2.13 THE HAMMER TIMING SEQUENCE

Following a SYNC pulse, Hammer Shift Clock pulses (NHSC) load 66 bits from the COM line into the hammer driver shift register. Every second bit (of 132 bits) on the COM line is clocked into the shift register, selecting dot information for only one of the two characters to be printed by each hammer.

After 132 milliseconds the last bit has been clocked into the shift register and the next SYNC pulse causes Hammer Clock (NHCK) to load the contents of the shift register into the 66 data latches.

The NHCK pulse also sets the Output Enable latch (OE) which enables 66 tri-state buffers to connect the contents of the data latches to 66 Darlington drivers. When a dot is to be printed, the data latch for that hammer is set and the corresponding Darlington driver transistor is forward biased. This completes the current path for the +36V DC supply through the hammer coil to ground, which energizes the coil. When the coil is energized the hammer is released, impacting the ribbon against the paper to print the dot.

All coils are de-energized when Hammer Reset (HRS) resets the OE latch, thereby disabling all tri-state buffers. This permits the rebounding hammers to be recaptured by the permanent magnet.

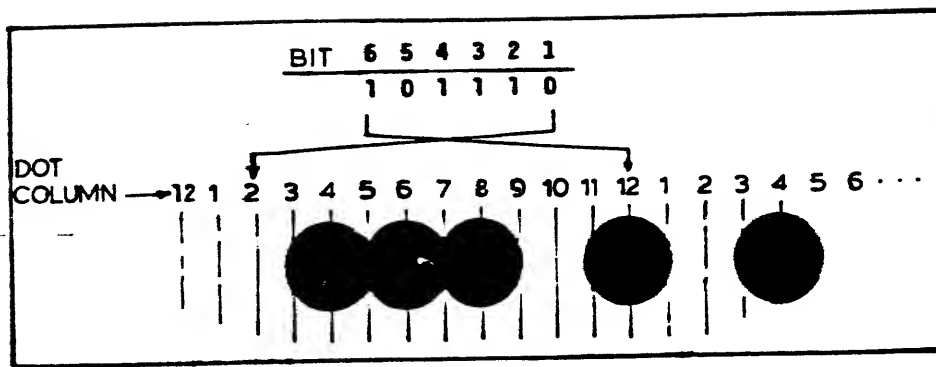


Figure 19 Plotting the Six-Bit Code

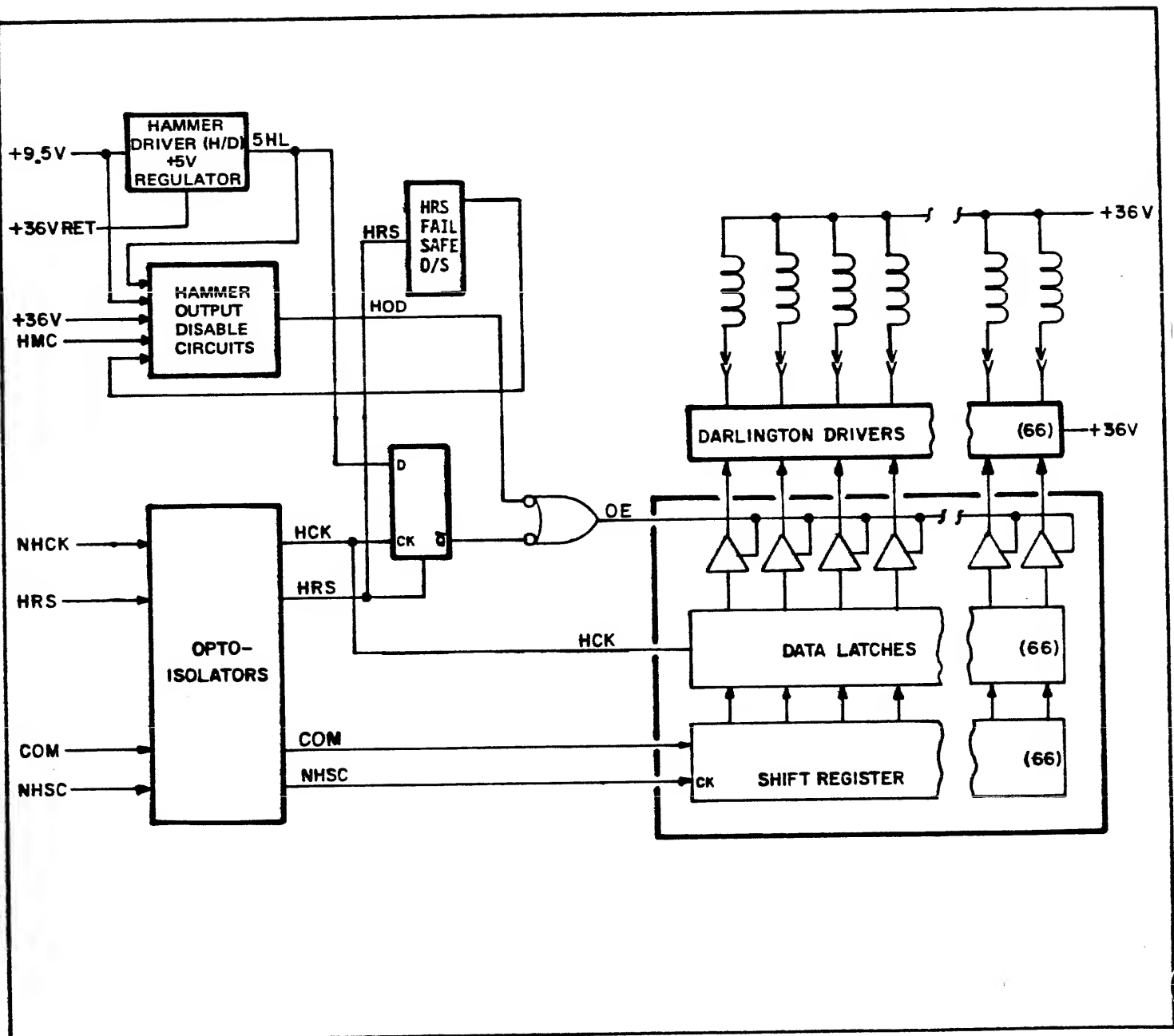


Figure 20 Hammer Driver Functional Block Diagram

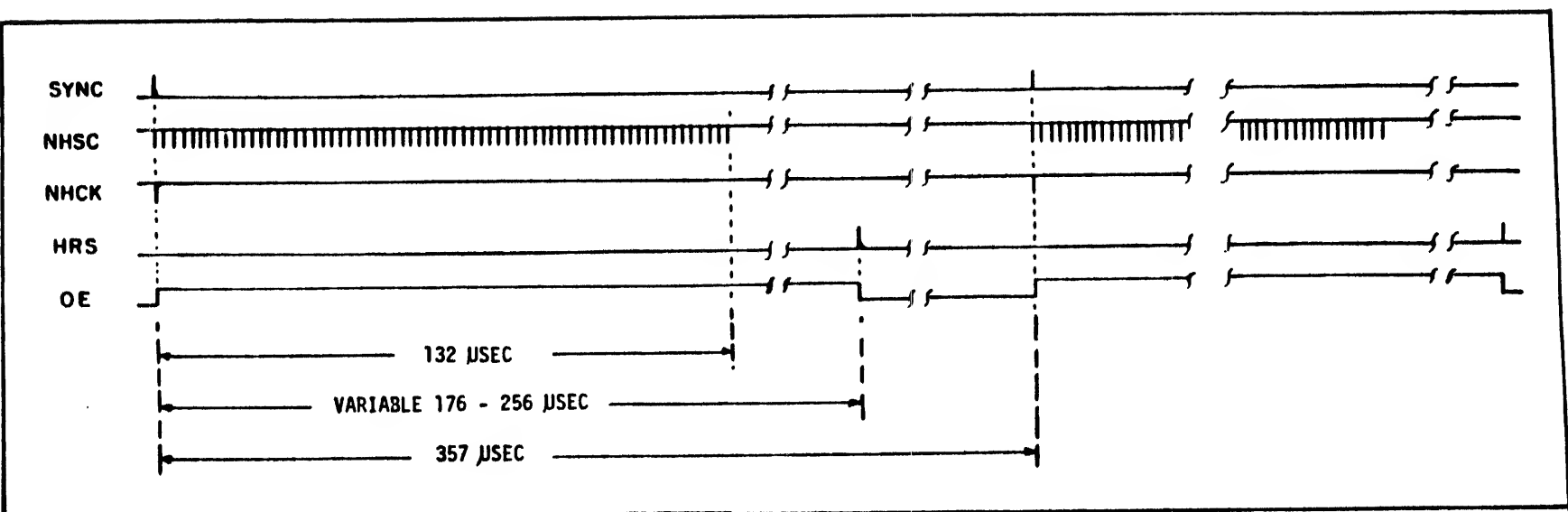


Figure 21 Hammer Driver Circuits Timing

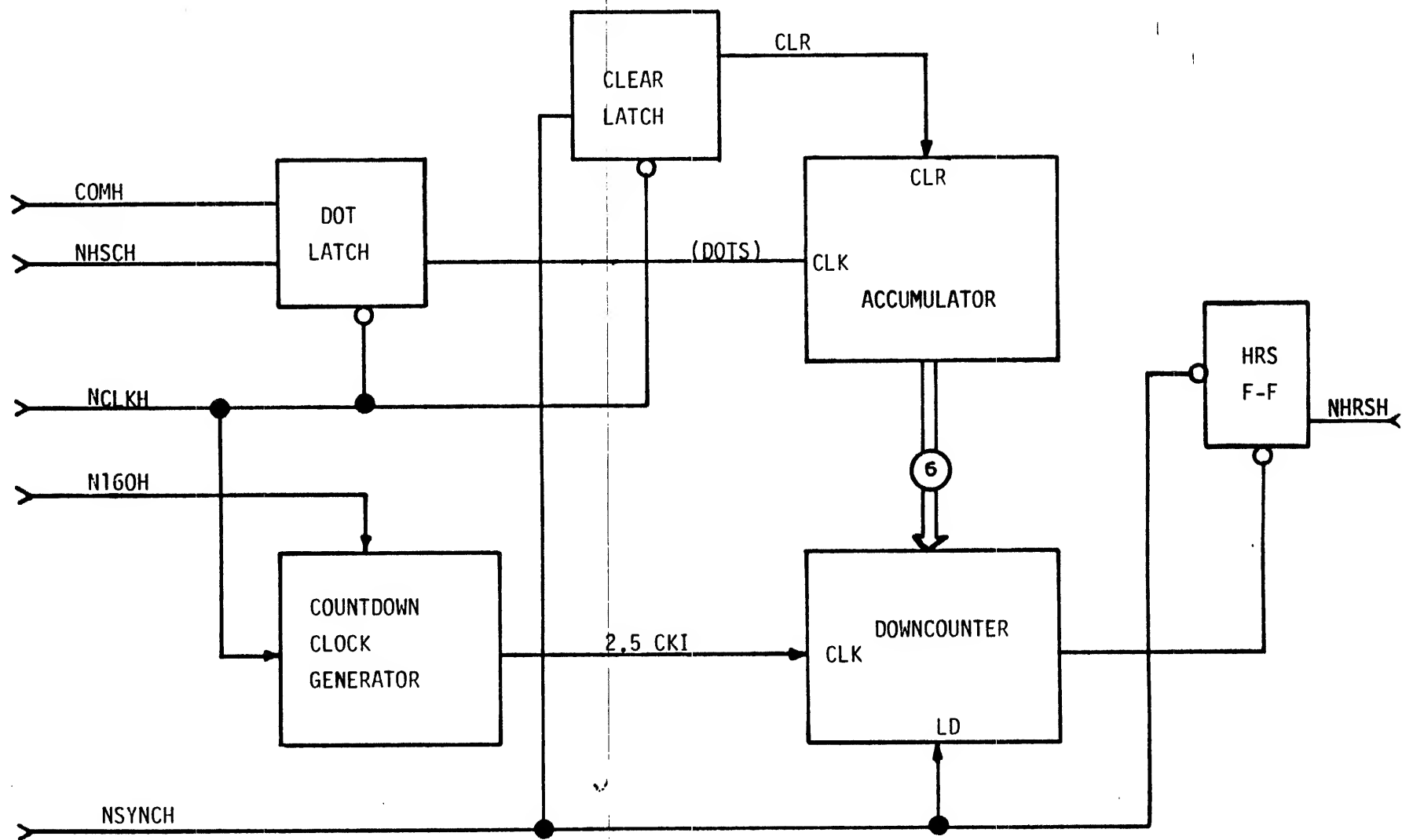


Figure 22 Hammer Driver Reset Timer Block Diagram

2.14 THE HAMMER DRIVER RESET TIMER

The duration of coil energization (the interval between the rise of OE and the generation of HRS) is variable, depending on the number of hammers that are to be energized for the specific dot column. If a greater number of hammers are energized (with more parallel resistance in the driver circuits), the coils are energized for a longer period. This maintains a relatively constant flight time for the hammers and preserves the uniformity of the printed image.

The timing of HRS is controlled by logic on the Hammer Reset Timer, a small printed circuit board mounted on the logic B PCBA. This logic counts the number of "dot bits" loaded from the COM line into the hammer bank shift register (by NHSCH) and it generates a corresponding time-out period. After the period has elapsed the logic raises Hammer Reset (NHRSH) to terminate coil current (Figure 22).

Data bits in the clocked COM signal are accumulated, starting at a given SYNC time. At the next SYNC period the accumulated dot count is transferred to a down counter. After a delay of 176 millisecond (N160H) generated by general purpose timing, a 2.5 millisecond clock (2.5CKI) begins to clock the accumulated dot count down to zero. When the counter underflows, it sets the NHRSH flip flop to generate HRS.

Hammer driver reset logic provides a variable delay of from 176 milliseconds (no dots clocked into the hammer driver shift register during that SYNC period) to 255 milliseconds (66 dots clocked into the shift register).

2.15 PAPER FEED STATE OPERATION

Movement of the paper tractors is controlled using a 4 phase stepper motor controlled by logic incorporating a counter and a velocity PROM. Logic is first set up for the particular paper feed operation (movement to next dot row, movement to next character line, slew, VFU operation, etc.) to establish a specific acceleration/deceleration profile for paper movement. The velocity PROM is then addressed by each dot row count to select the motor drive rate for that dot row. A high speed counter is continuously clocked during paper motion and the incrementing count addresses the PROM. The PROM contents for each address determine the paper motion drive pulse rate for that dot row.

Paper movement is performed for any of the following purposes:

- a. To advance paper to the next dot row within a character line (in Print state operation).
- b. To advance paper from the last row of a character line to the first row of the next character line to be printed.
- c. To advance paper through a complete character line space, without printing, to the top row of another character line.
- d. To slew paper through a number of line spaces to a specified line on the form, or to the Top of Form.
- e. To advance paper, in VFU operation, to the next line to be printed as the VFU searches for a specified channel number.

2.16 ENTERING THE PAPER FEED STATE

The Paper Feed State is entered when the dot row counter has counted the last row of printed dots in a character line, and those dots have been printed. When the count is seven (or nine when printing lower case descenders or underlines) row counter logic generates End of Print (EOP) enabling the next CLKB pulse to set the Paper Feed (PPF) flip flop.

The PPF flip flop may also be set by a “slew” (NSLW) state when there is no printable character in the printer buffer (NPC) and a form feed or VFU command is received.

The Paper Feed state is terminated and the Load Buffer (LB) state entered, when the PPF flip flop is reset by an End Paper Feed pulse (EPFP). EPFP is generated when:

- a. The row counter is rest (RCR).
- b. “Slew” (SLW) is negated.
- c. The final Paper Feed pulse (PF2) has been sent to the paper drive circuits.

2.17 PAPER FEED MOTOR DRIVE CIRCUITS

The paper feed motor is an incremental motor driven by two pairs of coils. The coil pairs are driven in a sequence: the electromagnetic detent locking the rotor is released, the rotor is advanced one increment, and then the detent is set again. One pair of coils is driven by push-pull signal $\phi A/\overline{\phi A}$, and the other pair is driven by $\phi B/\overline{\phi B}$ (Figure 23).

The motor drive signals are controlled by the 2 phase Paper Feed signals PF1 and PF2 generated in paper feed logic. Each pair of PF1/PF2 pulses increments the motor one step to advance paper one dot row.

When paper is to be advanced to the next character line, advanced to the Top of Form, to a Vertical Tab, or advanced under EVFU control, the corresponding profile of paper movement velocity is selected to obtain precise paper control. Paper is accelerated at a variable rate to optimize both speed and precision and decelerated at a variable rate that prevents overshoot. To achieve this modulated paper movement, paper feed logic generates PF1 and PF2 at a frequency regulated by addressed velocity PROM content.

2.18 PAPER FEED CONTROL LOGIC

PF1 and PF2 each control identical independent drive circuits. Either circuit operates in the following manner:

The PF_n pulse passes through gates and drives a push-pull current amplifier circuit which provides drive current through one pair of motor coils.

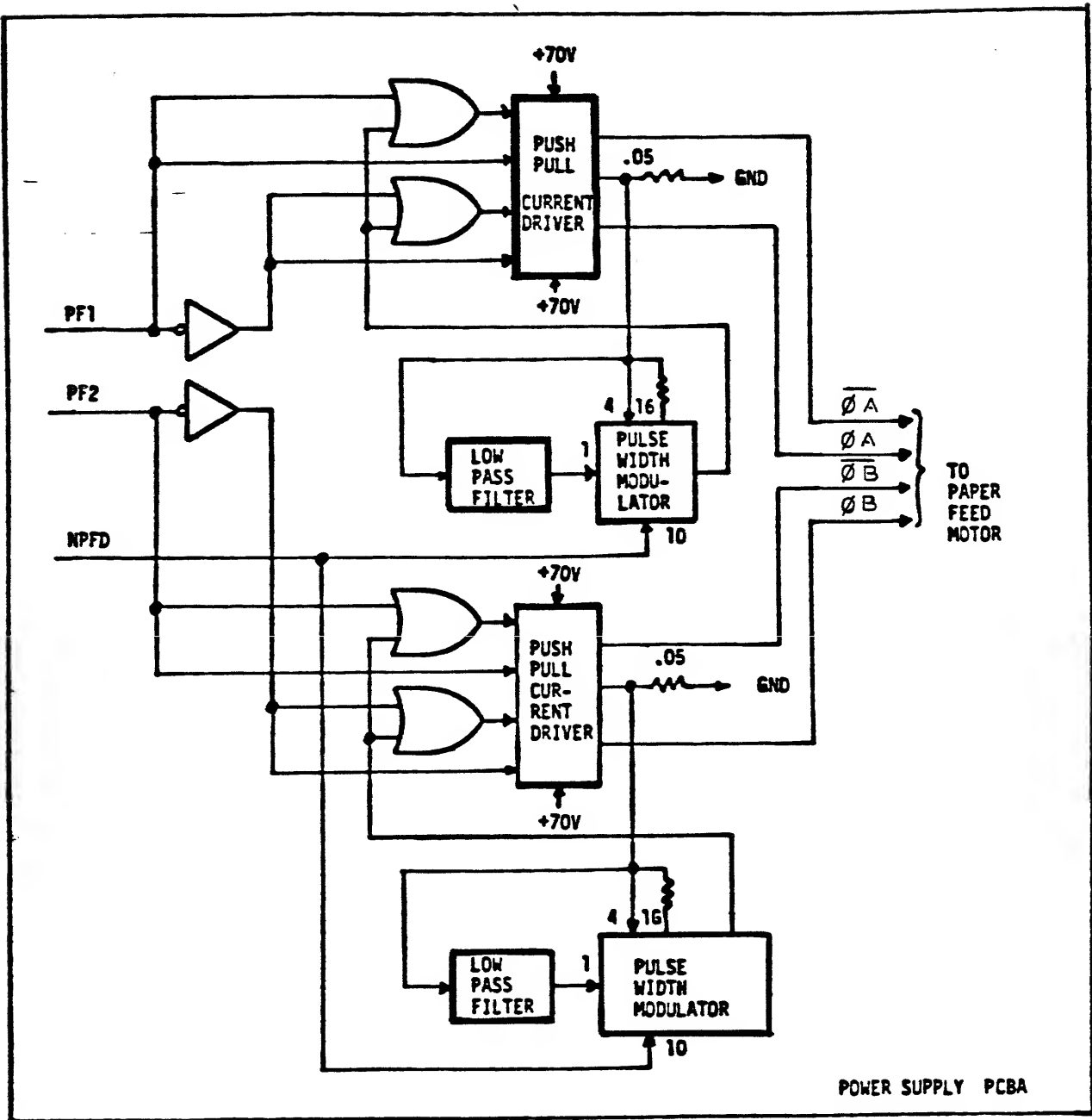


Figure 23 Paper Feed Motor Drive Circuits Block Diagram

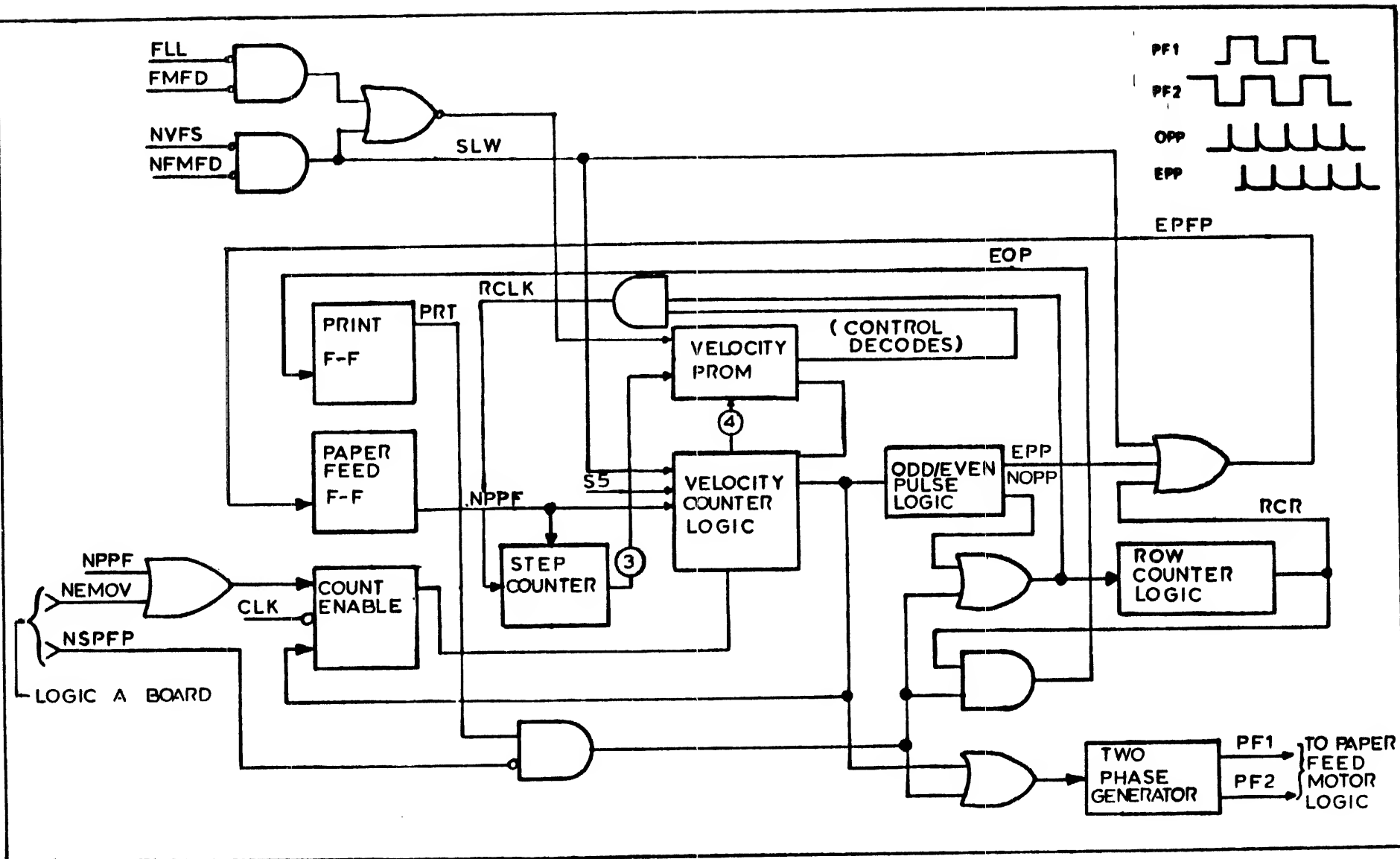
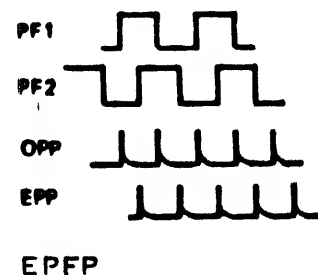


Figure 24 Paper Feed Logic Block Diagram

To stabilize the inductive current pulses (smoothing paper drive operation and protecting circuit components), a pulse width modulator device is used as a constant current controller. This circuit monitors the current flowing through the motor coils and controls the duration of the PF_n pulse as it appears at the input of the push-pull driver circuit. The effect of this loop is to maintain motor coil current at a relatively constant value.

The modulator is a single DIP chip having an "error" input at pin 1, a limit setting network at pins 4 and 16, a network (at pins 2 and 9) which establishes the frequency characteristic of the circuit and a "disable" (shutdown) input at pin 10.

Motor coil current is monitored across a 0.05 ohm resistor at the ground side of the push-pull driver circuit. This developed voltage controls the limiting action of the circuit and drives a differential amplifier which is the active element of a low pass filter. The filtered signal is the "error" input to the modulator device.

The output of the modulator is a pulse having a duration proportional to the input error signal. This variable width pulse gates the PF_n input to the push pull driver and, consequently, controls the duration of the motor drive pulse.

Either modulator circuit is disabled while the Paper Feed control signal NPF_D is high. The resulting "shutdown" signal at pin 10 of the device causes the output to completely turn off the push pull driver so that the motor cannot be stepped until NPF_D becomes low.

2.19 PAPER FEED TO THE NEXT DOT ROW

Paper movement to the next dot row during the Print state of operation is initiated when the NEMOV (Early Move) goes low. NEMOV is generated by dot column counter logic five dot columns (1.785 milliseconds) prior to shuttle reversal at either end of shuttle travel.

When NEMOV goes low, two events occur (Figure 24):

- a. Two phase generator logic (flip-flops in location 5D) is triggered, generating the Paper Feed pulse PF₁.
- b. The velocity counter (location 8H) is released permitting it to count S₅ pulses, each 16 microseconds in duration.

The binary code accumulated in the velocity counter addresses the PROM. When the counter has accumulated 182 S₅ pulses (2.048 milliseconds), the CLKA synchronized PROM output causes the following events to occur:

- a. The velocity counter is reset.
- b. Two phase generator logic is again triggered to generate PF₂, the second of the two pulses required to advance the paper drive motor one dot row.

When the row counter (Figure 24) has counted the last (seventh) row of the character line (or the ninth row when printing lower case descenders or underlines), End of Print (EOP) causes the end of the Print state and the initiation of the Paper Feed state (PPF).

2.20 PAPER FEED TO THE NEXT CHARACTER LINE

There are 12 dot rows from the first dot row of one character line to the first dot row of the next (nine rows for 8-LPI spacing). Paper movement is always moved in terms of dot rows. The dot row count keeps track of paper position whenever paper is moved more than one dot row.

When the Paper Feed state (PPF) is set by EOP, the count enable flip-flop (**Figure 24**) is set enabling the step counter. The step counter counts Row Clock (RCLK) pulses and addresses the velocity PROM which contains the number of steps in the acceleration and deceleration profiles (**Figure 25**).

As the count of RCLK pulses increments to 12 (or nine, at 8-LPI), each count selects the rate at which Paper Feed pulses are to be generated during the next dot row period. The velocity counter (**Figure 24**) counts 16 microsecond S5 pulses and applies a binary coded address to the velocity PROM. The addressed PROM contents determine the rate at which Paper Feed pulses are generated during the current period.

Each time after the PROM and velocity counter logic decode the programmed paper feed interval, the logic's output resets the velocity counter (enabling a new count) and clocks the two phase generator logic. This logic generates two outputs (PF1 and PF2) with alternate clocks from velocity counter logic. PF1 and PF2 control paper feed motor control circuits, with each PF1-PF2 pair advancing paper one dot row.

Odd/even logic produces Odd Paper Pulses (NOPP) and Even Paper Pulses (EPP), each of which occur at one half the Paper Feed pulse rate. NOPP clocks the row counter. EPP is ANDed with the Row Count Reset (RCR) signal as the last dot row of the line is counted, to generate the End Paper Feed Pulse (EPFP) as the paper feed operation is completed. EPFP clears the PPF mode which puts the printer in the Load Buffer state, ready to accept the next line of data.

The number of NOPP pulses required to generate RCR depends on the inputs to the row count decoder logic. These inputs are determined by the selected line spacing, as follows:

- a. At 6 LPI (normal), 12 clocks.
- b. At 8 LPI (selected by operator or program), nine clocks.

When paper advances from the last printed dot row of a printed character line to the first row space of the next character line, (**Figure 25**) paper advances six dot rows (6 LPI). However if the line contains no printable characters, paper is advanced a full 12 dot rows (at 6 LPI) in the PROM programmed velocity profile.

Figure 26 shows timing for a typical load/print/paper feed sequence for one character line.

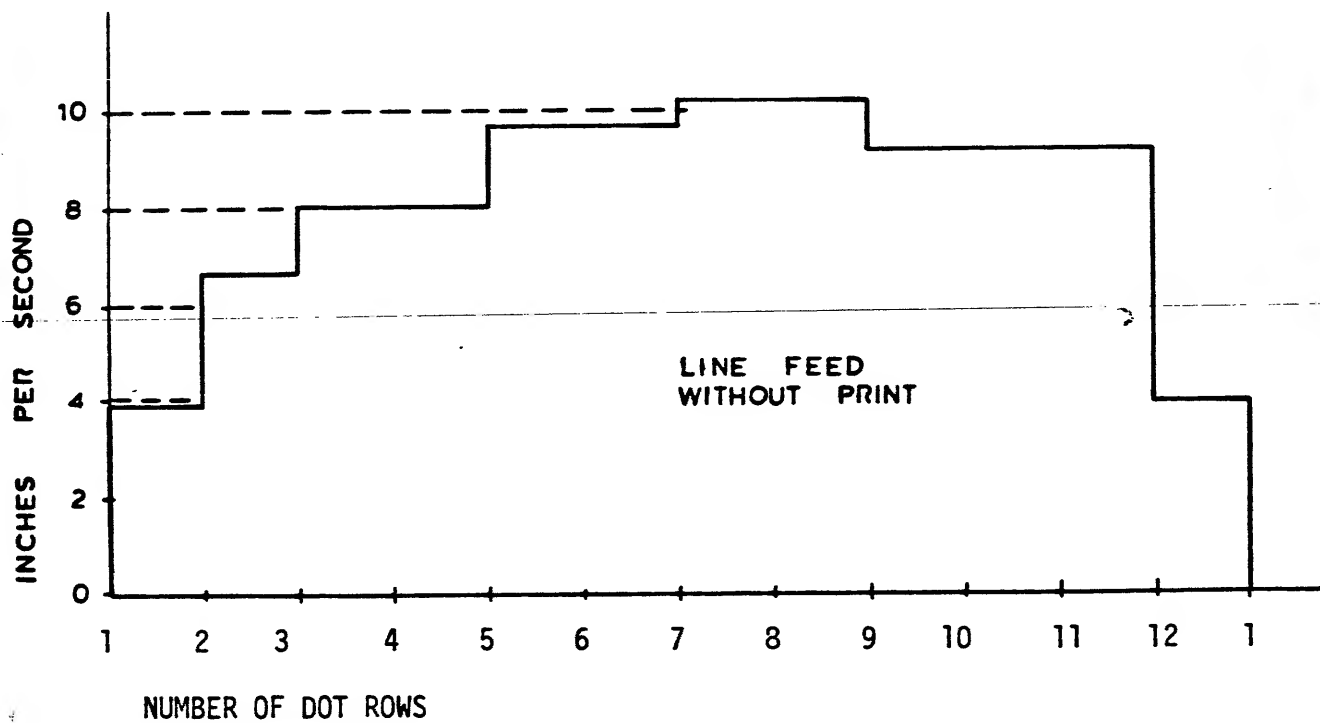
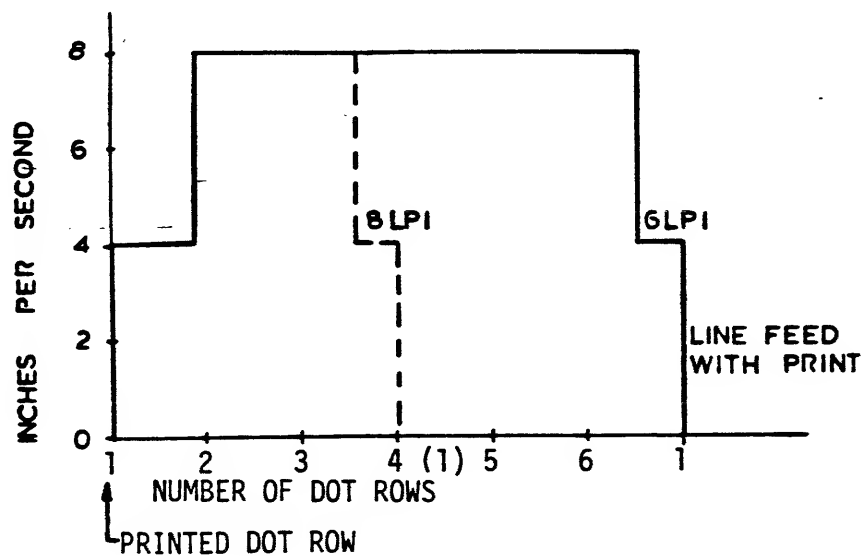
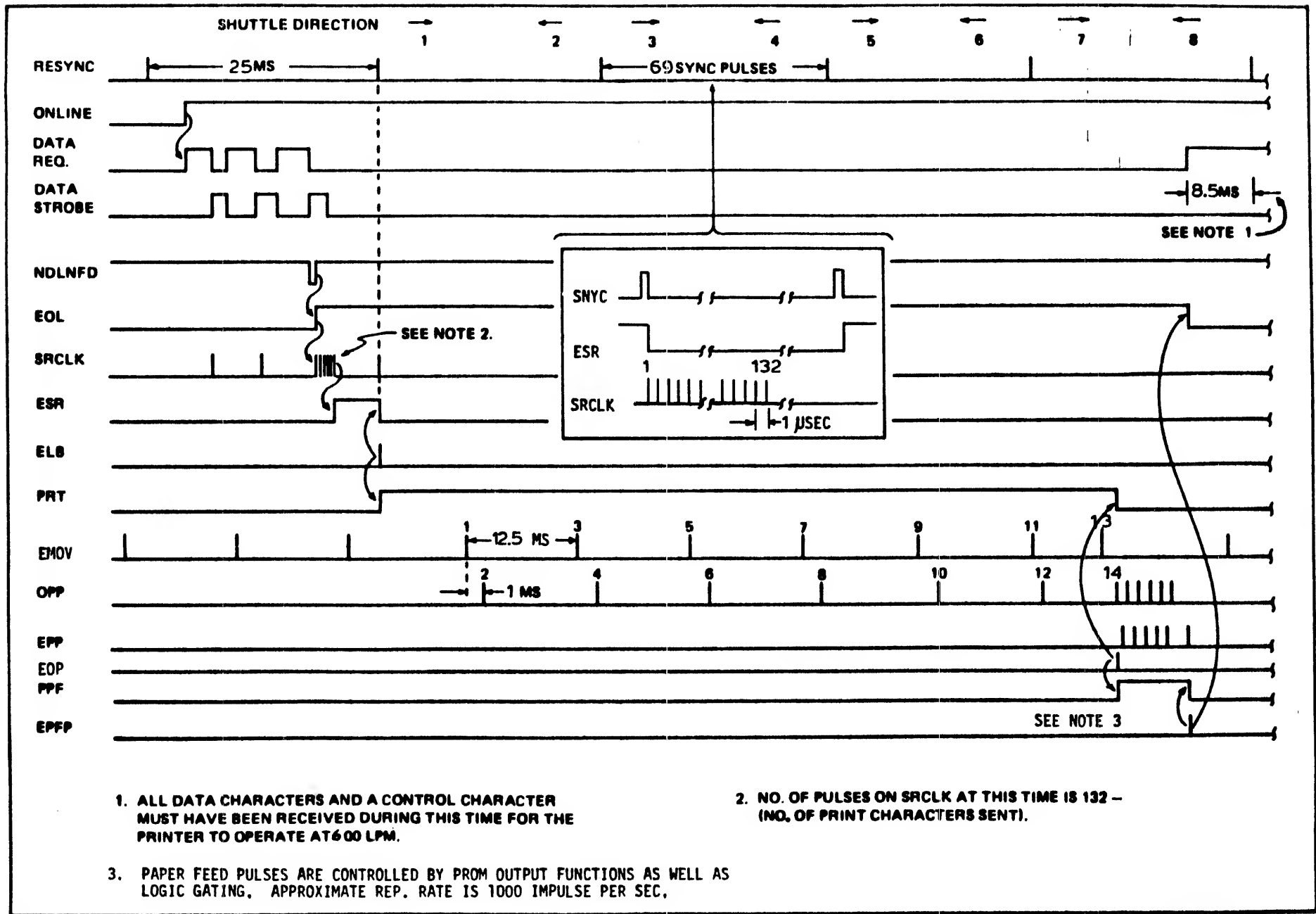


Figure 25 Line Feed Operation Velocity Profile

Figure 26 Typical Timing Sequence for Printing One Character Line



2.21 PAPER FEED TO THE TOP OF FORM

The Top of Form logic always maintains an accumulated count of dot rows and lines printed since the form was begun. If a Top of Form command is received, this logic controls the high speed movement of paper to the top of the next form.

The Top of Form command originates either at the TOP OF FORM pushbutton (STOF) or at the printer command decoder (NDFMFD). The resulting NTROF signal sets the FMFD flip-flop in Top of Form Logic (**Figure 27**). As NFMFD goes high, it generates the Slew (NSLW) (**Figure 24**) signal which holds off the End Paper Feed Pulse (EPFP) and modifies the address for the velocity PROM in the paper feed velocity counter logic. As shown in **Figure 28**, velocity counter logic then generates pulses at a rate that drives paper briefly at 4 IPS. The step counter and velocity counter in the velocity counter logic then cause paper movement to accelerate in stages up to approximately 16 IPS during the next 12 row counts, and then maintain that velocity until the next to last line of the form is detected (FLL) (**Figure 24**). FLL causes the velocity PROM and velocity counter logic to generate paper feed pulses at successively lower rates until paper movement stops following the last line of the form.

Two counters in Top of Form logic (**Figure 27**) keep a count of dot rows from the top of one form to the top of the next. The maximum form length is 66 lines, each comprising 12 dot rows. The row clock counter counts RCLK pulses. As a count of 12 is decoded, the counter is reset to begin the next row per line count.

Each time the row clock counter is reset, the line counter is incremented. The line counter counts lines until the next to last (65th) line is counted. This count is decoded to generate FLL, which modifies the velocity PROM address, resets the FMFD flip-flop (turning off NSLW), and clocks NEFF. NEFF simulates the final row count and sets Row Counter Reset (RCR) which produces EPFP. EPFP rests the PPF flip-flop to initiate the Load Buffer mode.

The final RCLK pulse increments the line counter to 66, clearing the line counter so that it is ready to begin the next form.

Figure 29 shows timing for a typical Top of Form operation.

2.22 SKIP-OVER PERFORATION

The row and line counters in top of form logic always count up to 792 rows (66 twelve row lines), whether or not a Top of Form operation has been initiated. The count is always with respect to the top of form, provided that the paper supply position is set properly to the top of form when it is loaded, and is not changed during power interruptions afterward.

The printer may be configured to cause paper to automatically advance a preset number of lines in advance of the bottom of the form. Thus, printing ends ahead of the bottom of the form and resumes below the top of the next form. This avoids printing on or near the perforation between forms.

To select this function, a code comprising the two least significant bits of the line count is decoded and ANDed with the encoded count of 60. Consequently, a Top of Form command is simulated at line counts causing paper to advance from three to six lines (or from four to eight lines for 8-LPI spacing) after the count is decoded.

The skip over distance is selected by connecting jumpers W1, W2, and W3 (Figure 25) on the Logic B PCBA. (Refer to the **Printronix Applications Manual** for instructions for selecting skip over distance).

2.23 FUNCTIONAL ELEMENTS

The basic P600 printer consists of the following functional elements (Figure 30).

- Printing mechanism — (Platen, Hammer Bank Assembly, and Shuttle Assembly)
- Paper transport
- Ribbon transport
- Control logic and character generation logic
- Hammer drivers
- Interface logic
- Safety circuits
- Electronic Vertical Format Unit (EVFU)
- Control switches and indicators
- The Power Supply Assembly

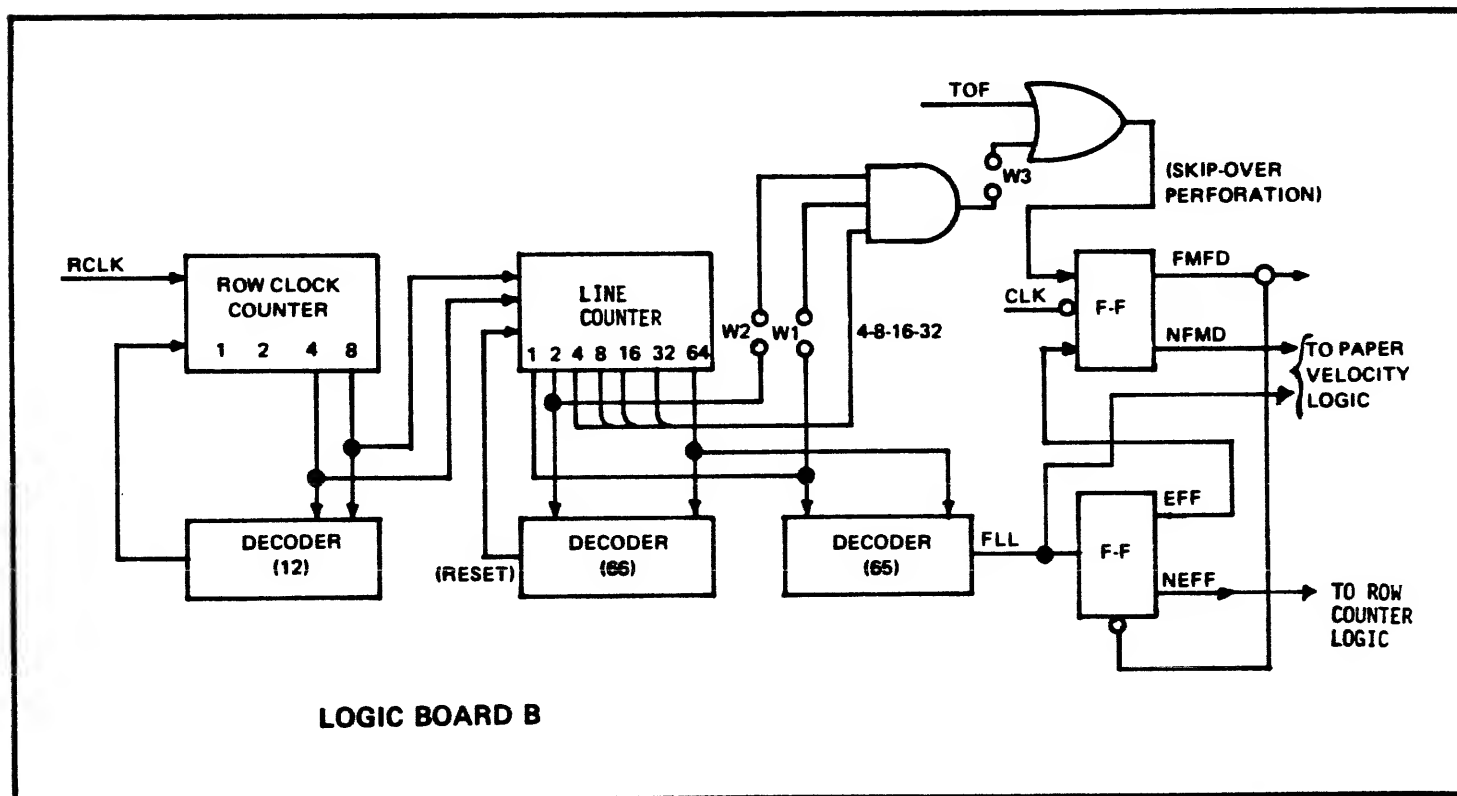


Figure 27 Top of Form Counter Logic Functional Block Diagram

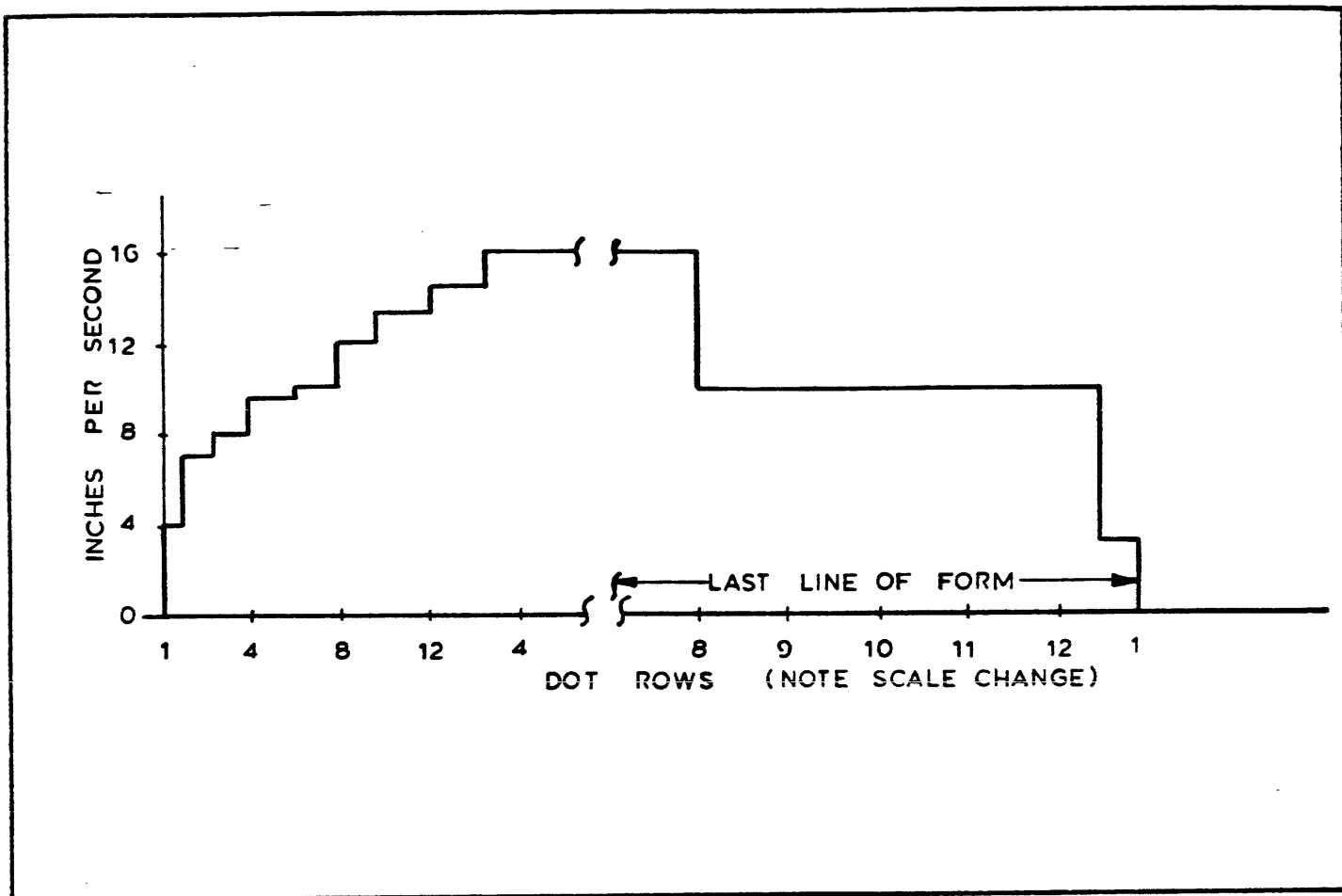
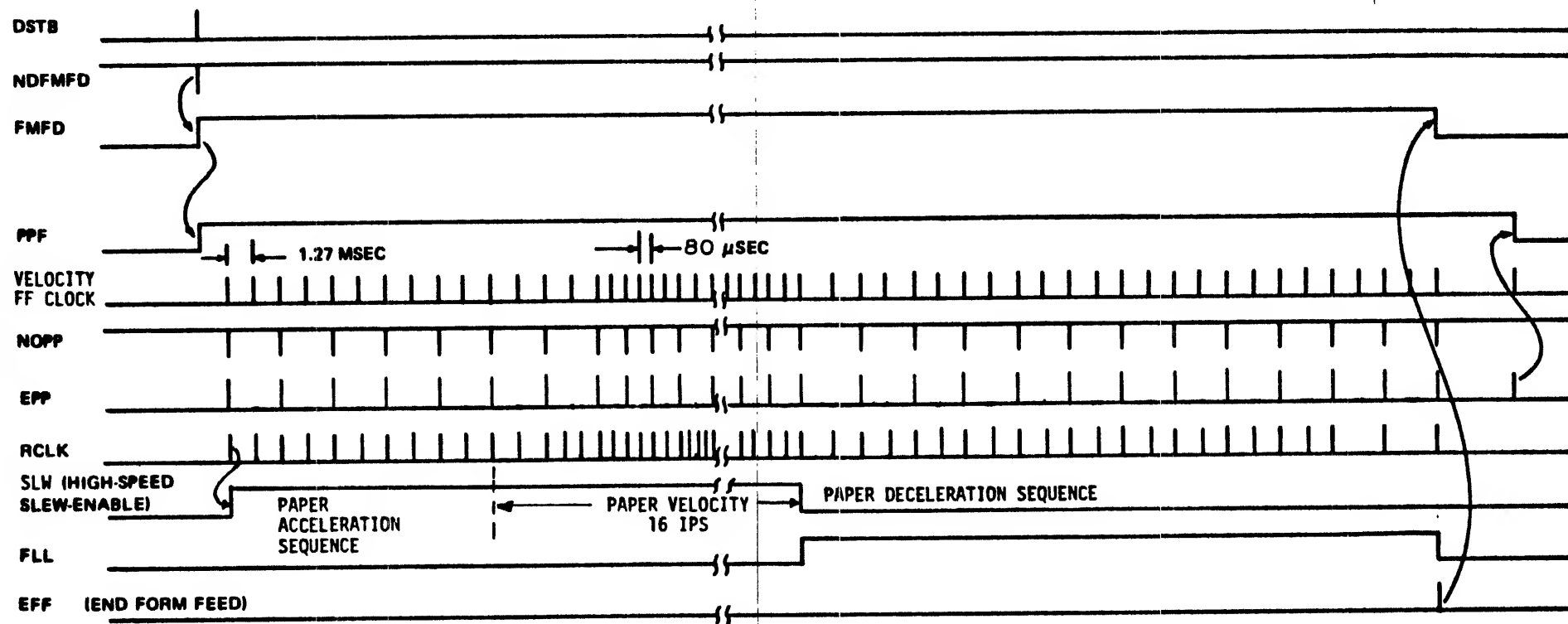


Figure 28 Top of Form for EVFU Binary Count Operation Velocity Profile



NOTES:

1. FOR A STANDARD 11-INCH FORM THERE ARE 792 RCLK PULSES PER PAGE.
2. BUFFER CONTAINS NO PRINTABLE CHARACTERS.

Figure 29 Paper Feed to Top of Form Timing

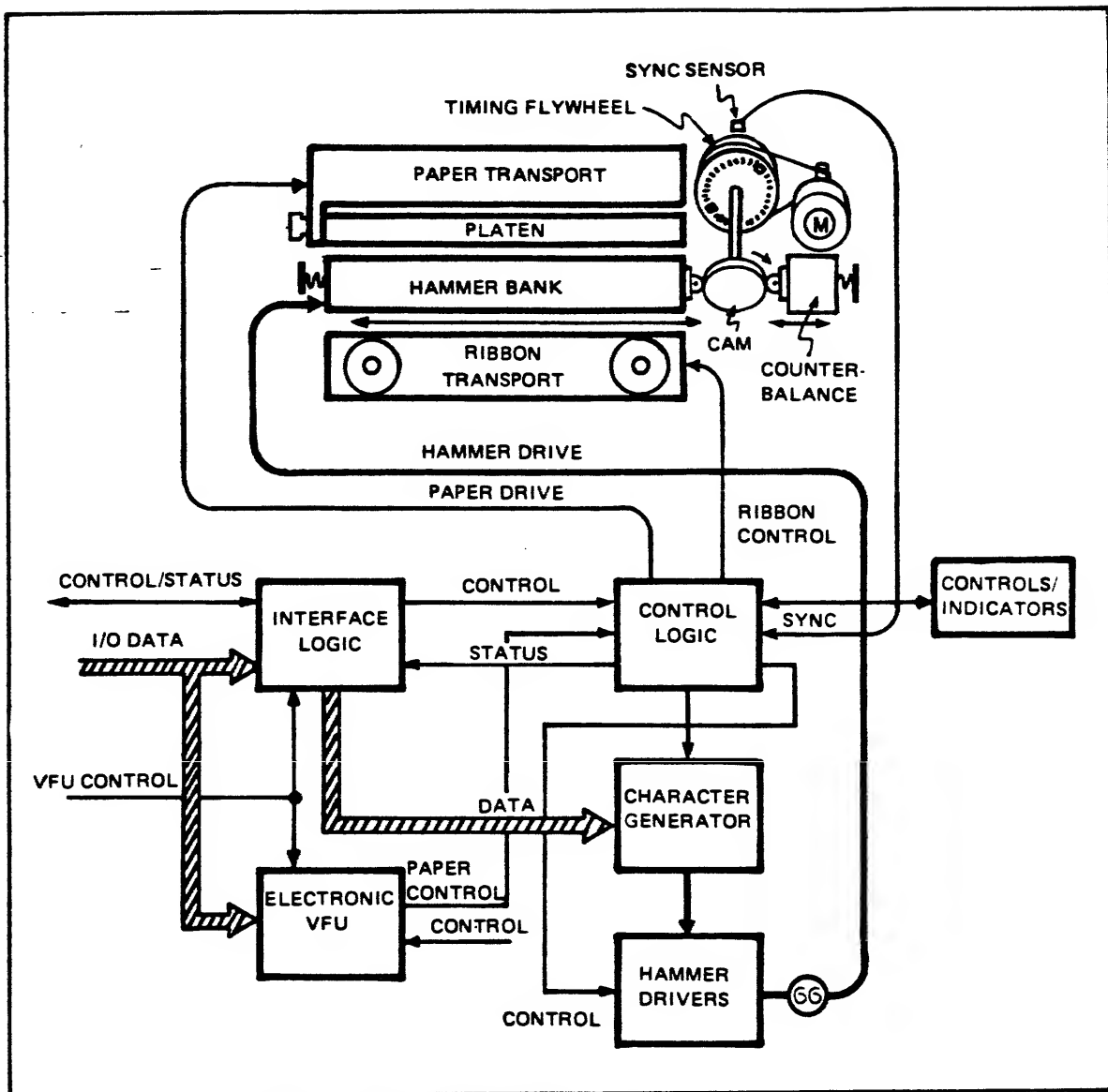


Figure 30 Printronix P600 General Functional Organization

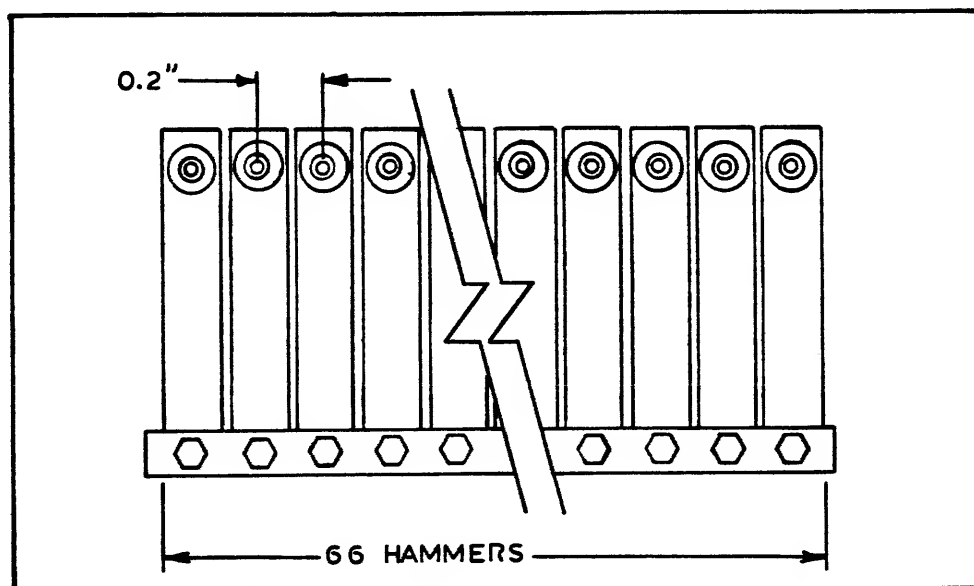


Figure 31 Print Hammer Arrangement

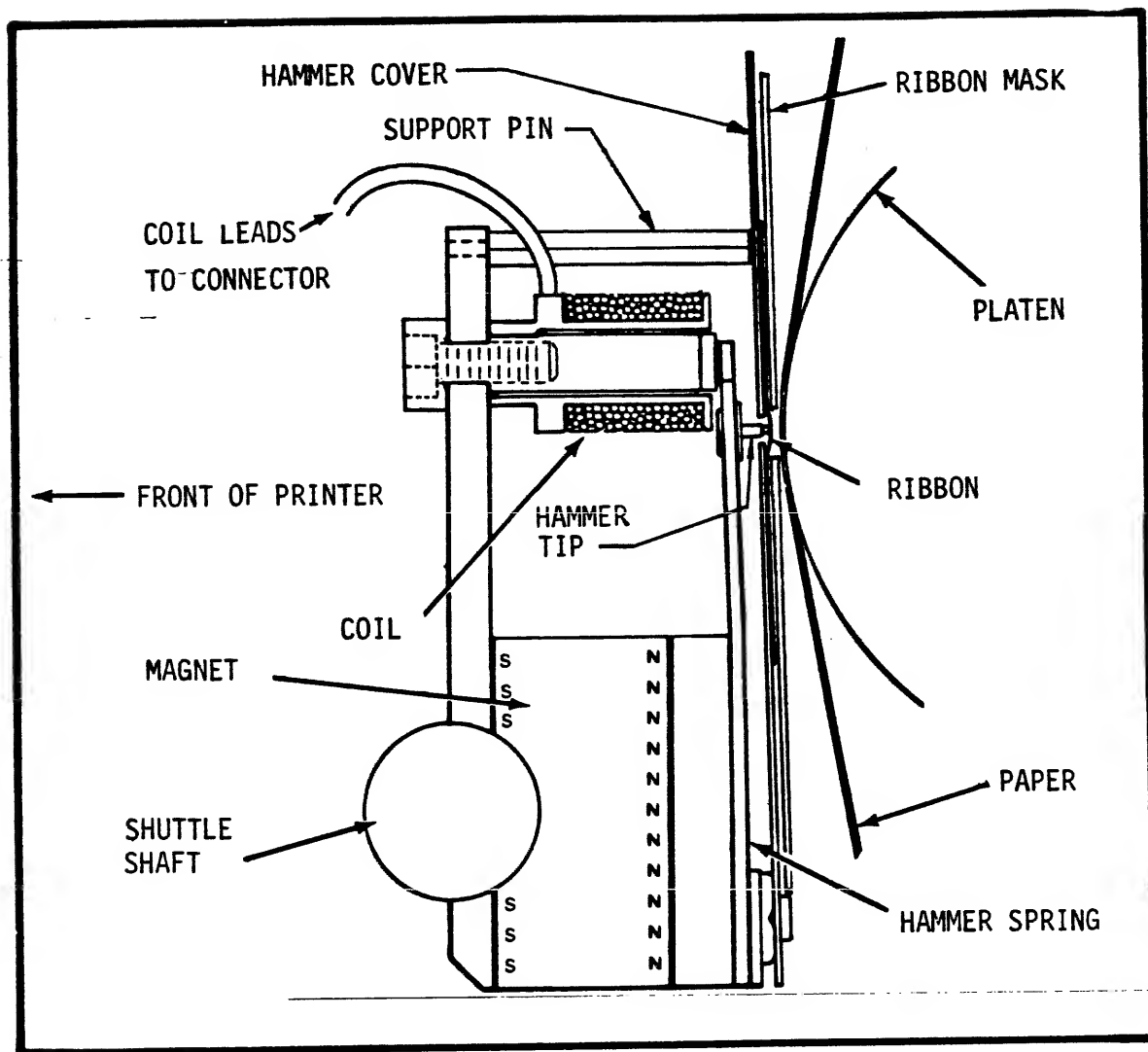


Figure 32 Hammer and Shuttle Arrangement, Cross Section

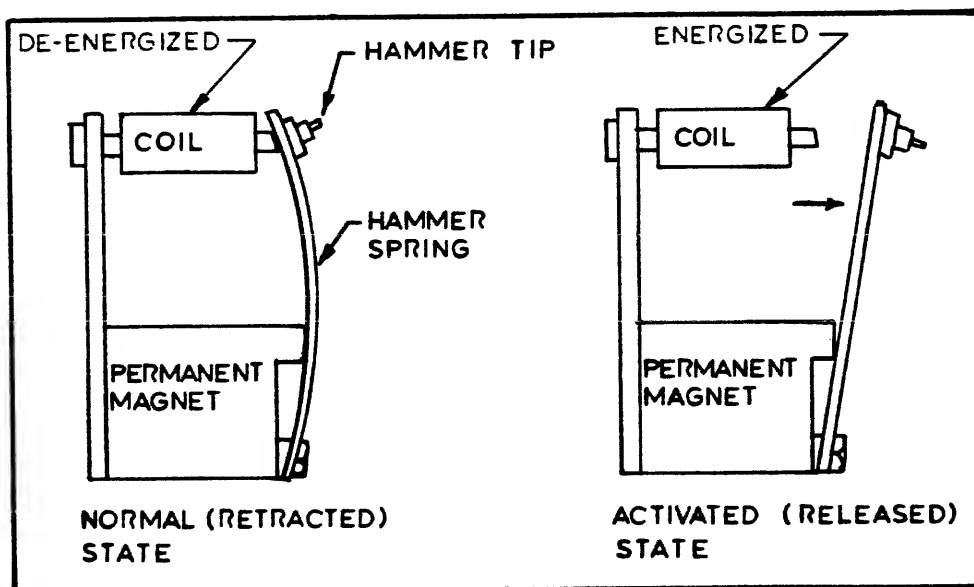


Figure 33 Print Hammer Action

2.24 THE PRINTING MECHANISM

The P600 prints a full character line at a time. Each line is generated, dot-row by dot-row, as the paper is advanced vertically through the character height.

Printing is done by a row of 66 print hammers (**Figure 31**), fixed to a shuttle which moves back and forth, horizontally, through two character spaces (approximately 0.2 inch). Each hammer prints the entire dot pattern of two adjacent characters. Therefore, the 66 hammers are able to print a full 132-character line ($66 \times 2 = 132$).

Each hammer is a stiff leaf spring held securely on the hammer bank by a screw passing through its end. At its other end is a pointed tip. A single permanent magnet, running the full length of the hammer bank, holds all 66 hammer springs in the retracted (tensioned) state.

Each print hammer is associated with a normally de-energized coil mounted on a magnetized pole pin (**Figure 32**), the end of which directly contacts the free end of the hammer spring. When hammer driver logic determines that the hammer is to print a dot, a current pulse energizes the coil. The polarity of the resulting electromagnetic field opposes the field of the permanent magnet, releasing the hammer to impact the ribbon and paper (**Figure 33**). Printing is accomplished when the hammer tip strikes the ribbon against the paper, leaving a dot of ink on the paper.

During flight time the coil is de-energized. As the hammer rebounds after striking, the permanent magnet again captures the hammer and holds it ready for the next stroke. Flight time is the same for all 66 hammers. Any hammer may produce up to 1350 impacts per second.

A line of characters is created by a scanning pattern (**Figure 34**). All dots in any row of the matrix are printed in a single scan as the shuttle moves from one side to the other through two character spaces. **Figure 35** shows the order in which a single character is formed by a single print hammer.

Successive rows of dots are printed as the paper is advanced one dot row (0.0139 inch) at a time, with the shuttle moving in alternate directions for alternate rows of dots.

The shuttle is moved through its horizontal scan by a double-lobed cam mounted on the motor driven flywheel. This cam produces two back-and-forth cycles for every revolution of the flywheel. Each cam lobe forces the shuttle to the left against the shuttle spring which returns the shuttle to the right as the cam revolves to its low point/null (**Figure 36**).

As the shuttle is driven to the left the other cam lobe drives the counterweight to the right against the counterweight spring. This spring returns the counterweight to the left as the cam revolves to its low point (**Figure 36**). This symmetrical arrangement reduces vibration by balancing the horizontal reaction forces of the shuttle.

Printing is synchronized with the shuttle movement by means of a magnetic timing disk on the rear surface of the flywheel. Apertures in the magnetic timing disk are sensed by a magnetic pickup to provide hammer stroke timing and synchronization of counting circuits to each horizontal scan. Each revolution of the disk synchronizes two back-and-forth cycles of the shuttle, while each double width aperture in the disk resynchronizes the cycle.

As the character line is being created, paper is advanced to successive dot rows each time the shuttle slows and reverses direction.

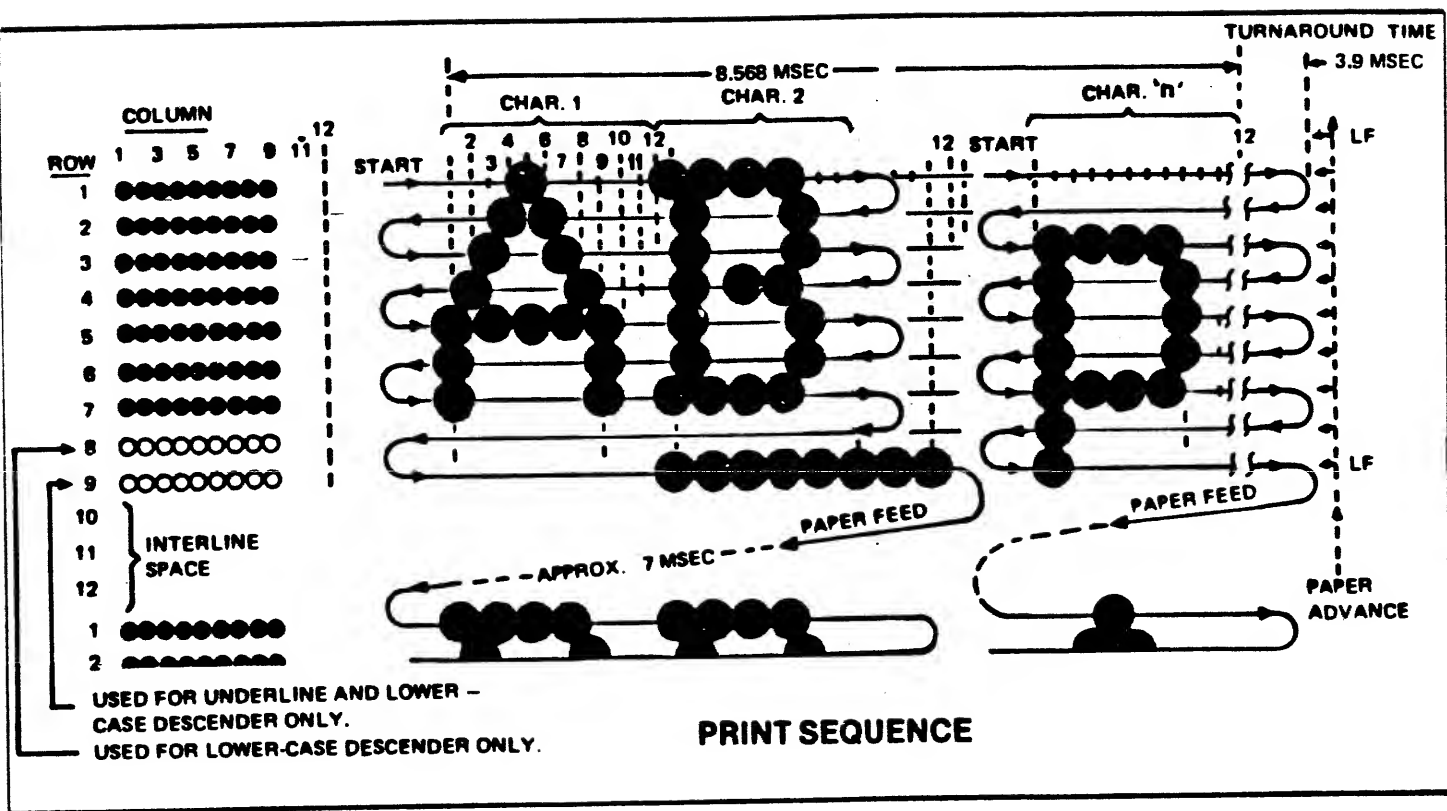


Figure 34 Standard Character Formation

2.25 THE PAPER TRANSPORT

The paper transport (Figure 37) handles fan fold, edge perforated paper up to 16 inches wide. Paper position is controlled by two movable tractors utilizing 8-pin engagement with the paper. Only the right-hand tractor is movable over the full width of the hammer bank. A horizontal vernier permits adjusting the paper position laterally over a range of two character spaces.

Paper is advanced by an incremental motor which moves the paper in 0.0139 inch increments for each dot row within the character. Paper advance may also occur in response to:

- Decoded Line Feed
- Decoded Form Feed
- EVFU command
- Pressed Top of Form or Paper Advance pushbuttons on the control panel.

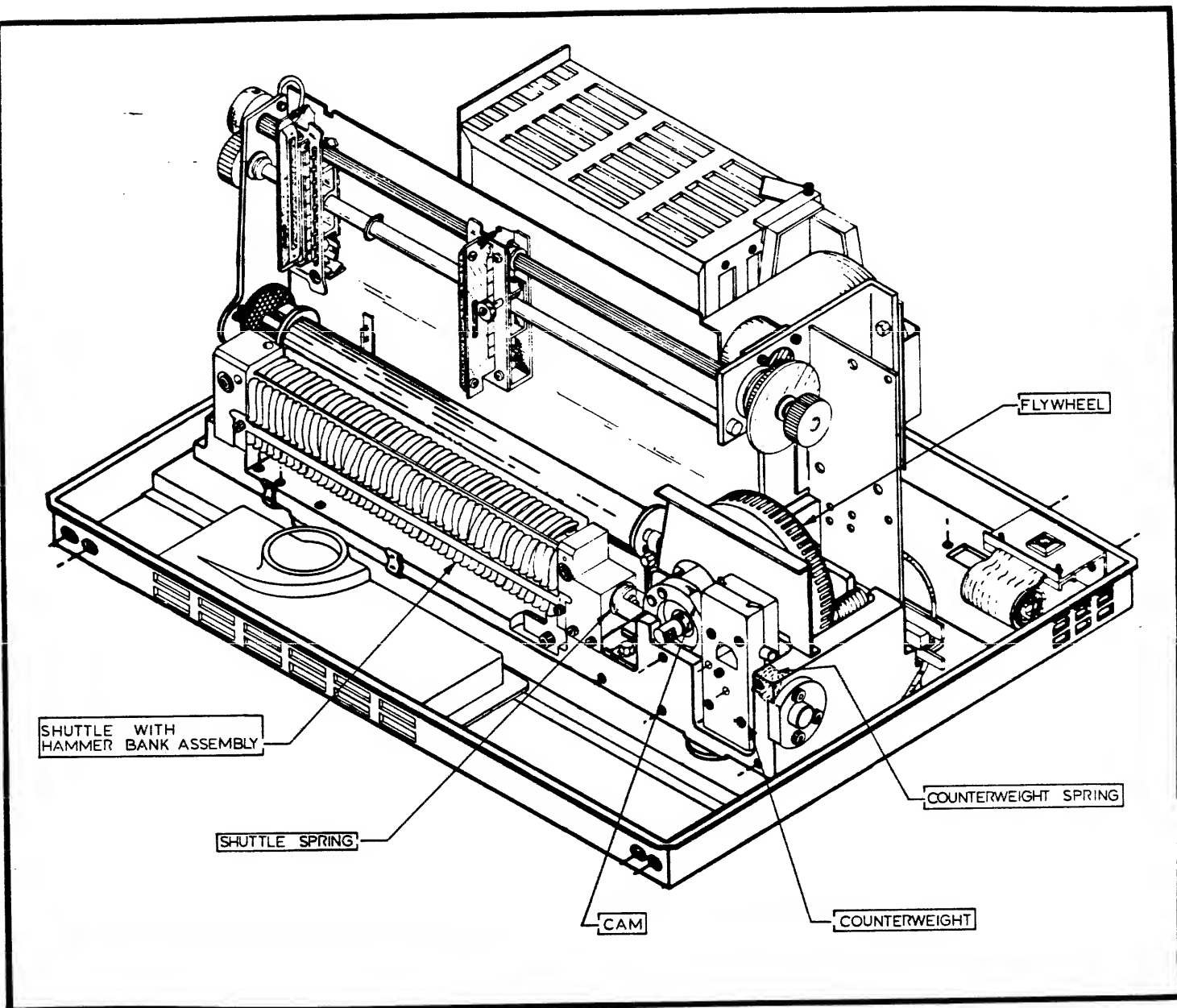


Figure 36 Hammer Bank/Shuttle Components

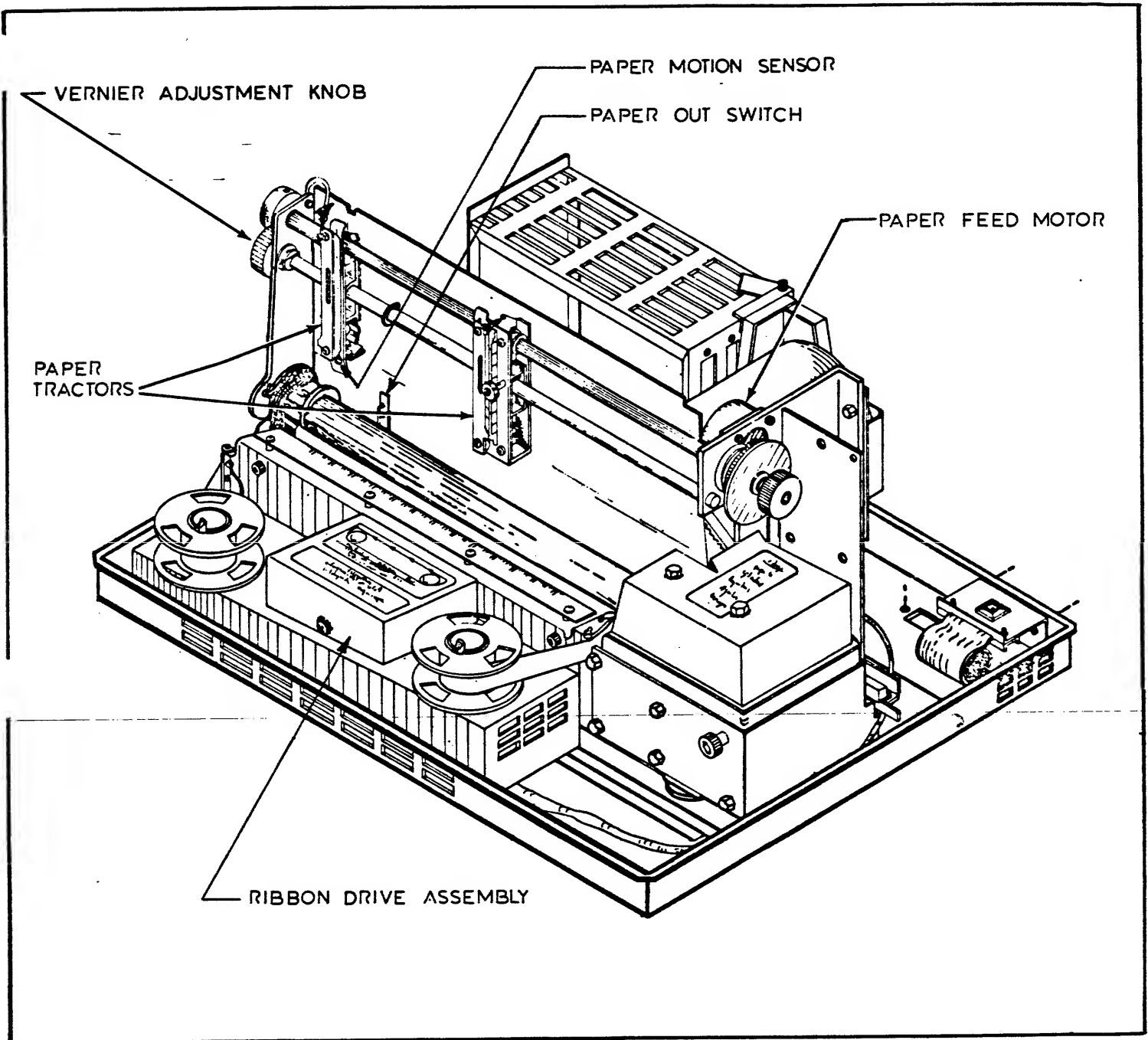


Figure 37 Paper Transport Components

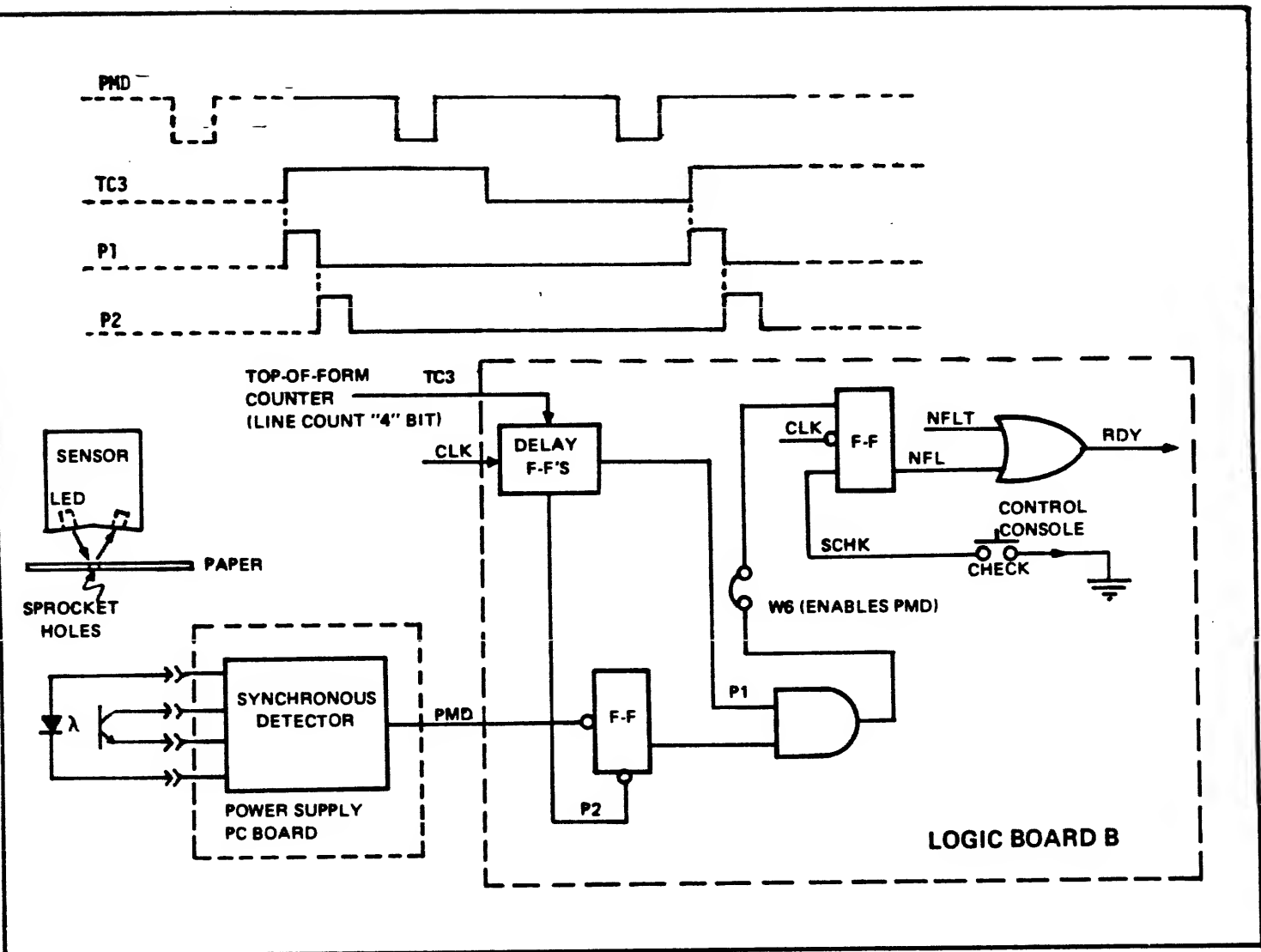


Figure 38 Paper Motion Detector Logic Functional Block Diagram

A paper out switch ends printer operation and turns on the CHECK indicator for either of two events:

- a. There is no paper detected two inches below the print station the printer is out of paper.
- b. The Forms Thickness Adjustment lever has been left in the Load position (paper is not being held correctly at the print station).

The paper out switch is normally held open by normal paper tension below the print station. The paper-out detector circuit may be strapped so that the CHECK indicator is not turned on when the end of the paper is reached. Thus the printer is allowed to operate until paper has advanced two inches past the detector. The printer is thereby permitted to print to the end of the paper.

The paper motion sensor detects movement of the sprocket holes near the left-hand edge of the paper and is mounted on the left tractor. It ends the printing cycle if paper has become jammed at the platen, or has been pulled out of the paper tractors. Either condition turns on the CHECK indicator.

2.26 PAPER MOTION DETECTION LOGIC

This logic detects the condition when paper is jammed in the printer while the paper tractors are being driven. Paper movement is detected using an LED emitter/phototransistor sensor which looks at the paper in the line of sprocket holes. When paper is in front of the sensor, reflected light causes the sensor output to go high. When the sensor sees a sprocket hole, the sensor output goes low.

Paper motion detector circuits check the sensor output every 8 character lines. If the sensor output has not changed from high to low during this interval, the paper motion fault flip-flop is set, READY is negated (inhibiting further data transfer to the printer) and the CHECK indicator is turned on. Because there are two sprocket holes in every eight line interval on the paper, the logic has two chances to detect a fault during that interval.

Figure 38 illustrates paper motion detector logic. The sensor output is applied to a tone encoder circuit on the Power Supply printed circuit board. This circuit uses a phase locked loop generating a frequency which excites the LED in the sensor. If the sensor sees paper, its output is a signal at the oscillator frequency, causing the output of the phase lock loop (PMD) to be true.

If, however, the sensor sees a sprocket hole (emitted light is not reflected to the phototransistor), the sensor output is low and the loss of phase lock causes the PMD signal to become false.

Circuits on the Logic B PCBA check the state of the PMD signal every eight lines by checking it with the signal TC3, which is stage 3 in the Top of Form counter. If the state of PMD has not changed within the 8 line interval (no sprocket hole has passed the sensor), RDY (Ready) is negated and the CHECK indicator is turned on. The fault is cleared by correcting the problem of jammed paper, and then pressing the CHECK switch on the console. When certain colored forms are used, the lower reflectivity of the paper surface may cause an occasional false paper motion fault. This paper motion fault may be defeated by removing the jumper W6 (location 8K) on the Logic B PCBA.

2.27 PAPER OUT SWITCH LOGIC

This logic detects the condition where there is no paper at the print station (paper out) or where the operator has left the platen in the LOAD Position.

Either condition is sensed by the paper out switch which is mounted on the belt cover. This switch is held in the closed position either by pressure of the open platen against the switch mounting arm or lack of pressure of the taut paper against the actuating arm. Either state causes the CHECK indicator to light and stops printer operation.

When the switch is closed, NFLT goes high and the troubleshooting "paper out" LED on the Power Supply PCBA is turned on. NFLT enables a count which then begins to count TFLC (Top of Form Line Counter) pulses, each representing one character line.

The paper out switch is mounted approximately two inches, (12 line spaces), below the print station. Therefore, when the counter has counted 12 TFLC pulses the Ready signal (RDY) is made to go low, inhibiting further input to the printer and the CHECK lamp is turned on.

The paper out fault is cleared by simply closing the platen or loading paper in the printer.

Note that this fault, as well as a paper motion fault, is recognized only when the printer enters the Load Buffer mode of operation.

2.28 THE RIBBON TRANSPORT

The printer ribbon advances continuously on the Ribbon Drive Assembly while the shuttle is running and stops when the shuttle stops. Ribbon motion is reversed when a wire threaded through either end of the ribbon is detected.

Constant ribbon tension is obtained by using DC servo motors in a differential drive circuit.

2.29 RIBBON DRIVE CIRCUITS

These circuits drive the ink ribbon from one spool to the other. The ribbon passes between the hammer bank and the platen while lying within the Hammer Bank Cover Assembly. Ribbon travel is automatically reversed when a wire woven through the ribbon at either end is detected by a sensor on the ribbon guide it passes over.

The ribbon is driven by two DC motors in a servo circuit. At any moment while the shuttle is in motion, one motor acts as a driving motor drawing the ribbon against resistance exerted by the other motor. This system maintains a constant motor speed and ribbon tension. When the end of the ribbon is detected, the two motors exchange roles. **Figure 39** illustrates circuits which are located in the Ribbon Drive Assembly.

Ribbon may be moved only while the shuttle drive motor is energized; that is, ribbon is moved whenever printing is taking place. The high side of the AC shuttle drive circuit (which also powers the hammer bank blower) is switched by a triac switching circuit controlled by signal NSD. The switching circuit consists of an opto-isolator device and a zero crossing detector circuit. The optical device isolates the control logic from the AC power circuit. The zero crossing detector prevents an excessive switching transient by switching the triac only when the AC voltage passes through zero volts.

Figure 40 shows ribbon control circuits. The NSD signal enables gates which control switching to the ribbon drive servo.

When an end of ribbon sensor is activated, it establishes the corresponding latch in a state which turns on the related FET. If, for example, the left-hand sensor resets the latch, FET Q1 acts as an open circuit and Q2 conducts connecting the divider of Amp K2 to the upper end of resistor R_C . This connects motor M1 as the driving motor, with drive current flowing through constant voltage amplifier K1, motor M1, and resistor R_C .

When the right-hand end of the ribbon is detected, the latch is set to the opposite state and the motors reverse roles.

When the shuttle motor is not running (NSD is high), both FETs are held off and the motors act in opposition, as the voltage across R_C provides feedback to resist ribbon movement.

2.30 CONTROL LOGIC

This logic receives SYNC information detected on the rotating timing disk and provides position information that:

- a. Relates each stored input character to a particular print hammer.
- b. Provides timing to scan the dot pattern information from the character generation logic during the printing operation.
- c. Decodes function and paper advance commands received through the interface.

2.31 CHARACTER GENERATION LOGIC

Character generation logic decodes each character code received by the printer to produce a matrixed pattern of dots to represent that character.

A dot pattern for each different character is stored in PROM devices. Each dot row per character appears as a stream of pulses over one of nine lines, one line for each horizontal dot position in the character matrix. These pulses represent the dots and are multiplexed to the hammer driver circuits.

The standard 96 character ASCII code is received on data lines 1 through 7, and is converted to equivalent dot patterns by addressing the standard plug in PROM devices. Additional PROM devices may be installed in optional board sockets and addressed to decode additional characters up to a total of 160 different characters. When an optional character set is used, data line 8 is normally used as a "shift" command line to select either the standard set or the optional set.

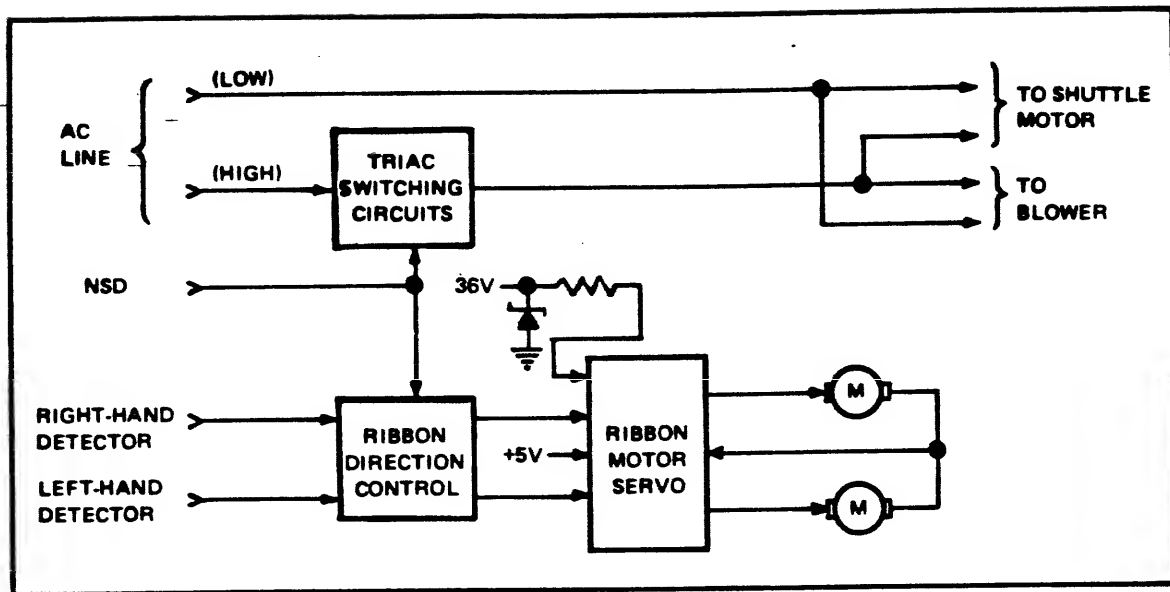


Figure 39 Ribbon Drive Assembly Functional Block Diagram

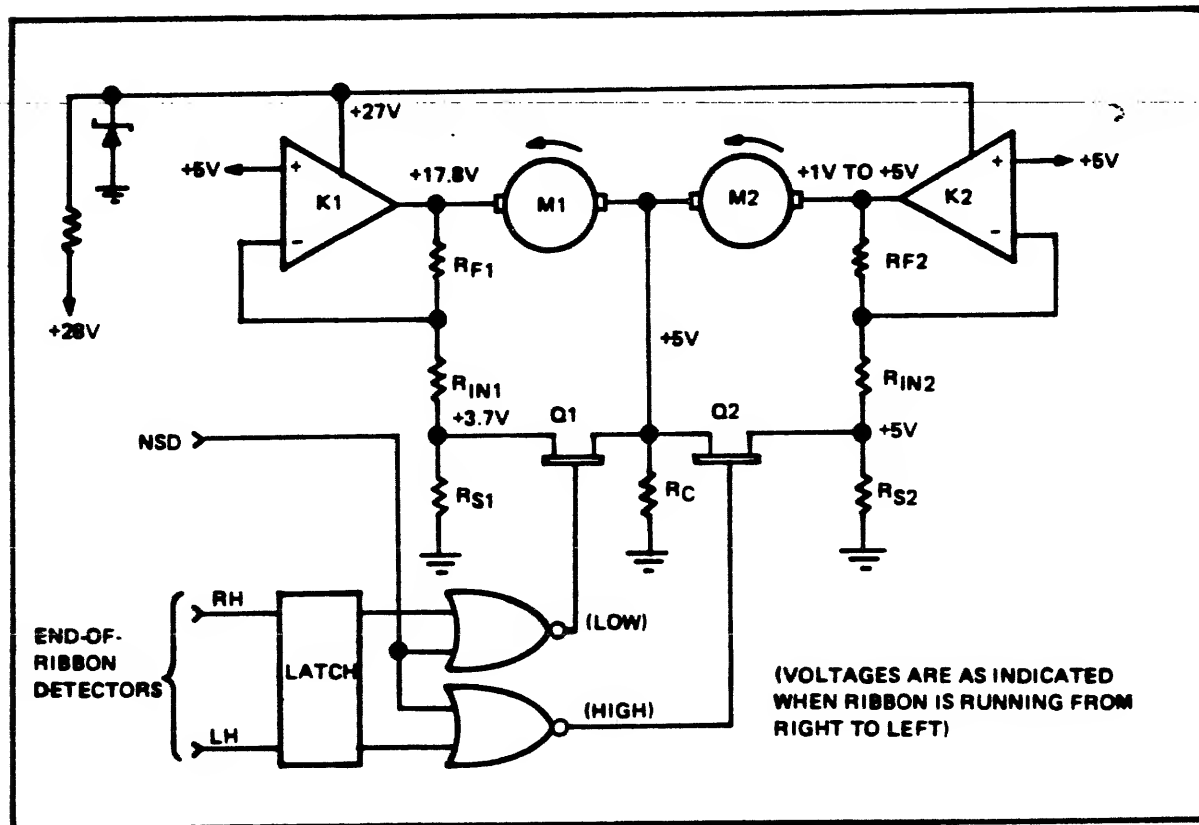


Figure 40 Ribbon Control PCBA Simplified Schematic Diagram

2.32 THE HAMMER DRIVERS

Single dot information for a location within the matrix is multiplexed from character generation logic and stored in a latch. When all 66 latches contain a specified “print” or “no-print” state for that dot location, all hammer driver circuits are strobed. This causes those circuits in the “print” state to deliver a current pulse (approximately 2 amperes) to their related print hammer coils, releasing the hammers. Coil current is cut off during hammer flight so that the rebounding hammers are recaptured by the magnetized pole pins.

2.33 INTERFACE LOGIC

Interface logic receives a stream of coded information from the controller, evaluates this information and generally classifies it as a printable character or a function code. Printable characters are stored in a 132 character register. Functional codes are decoded to control the paper transport and EVFU, and provide the “handshaking” cycle by which the printer communicates with the controller.

Interface logic (located on the Logic A PCBA) links together the remote controller and the printer. **Figure 4** is a block diagram of interface logic function. **Figures 41** and **42** show the timing of events in the logic for Data Products compatible and Centronics compatible interfaces.

Table 2 lists and describes signals exchanged between the printer and the controller.

Principal elements of the block diagram are:

- a. Receiver circuits (Schmitt trigger input) — Restores leading and trailing edges to degraded digital signals and provide noise immunity.
- b. Open collector drivers — Transmits signals to the remote controller.
- c. Polarity logic (Exclusive OR gates) — Selects either a high true or low true interface logic sense. Jumper W7 (location 8K) is installed for a low true interface, and omitted for a high true interface.
- d. Latch circuits — Receive data characters, function codes, and paper instruction codes which are stored until they can be transferred into the printer buffer, EVFU, or control logic.
- e. Strobe timing circuits — Control both internal functions, and the Data Request (DR) or ACK signal outgoing to the controller.

The printer asserts the IDR signal to indicate that it is ready to receive a data byte. The IDR signal is reset when the controller send a strobe pulse and data byte in response. The received data is loaded into the latches, and a flag bit is set in the latch to initiate the internal strobe timing sequence shown in **Figures 41** and **42**. The latches are reset after either:

- a. Printable data has been transferred into the printer buffer.
- b. A command code has been decoded.

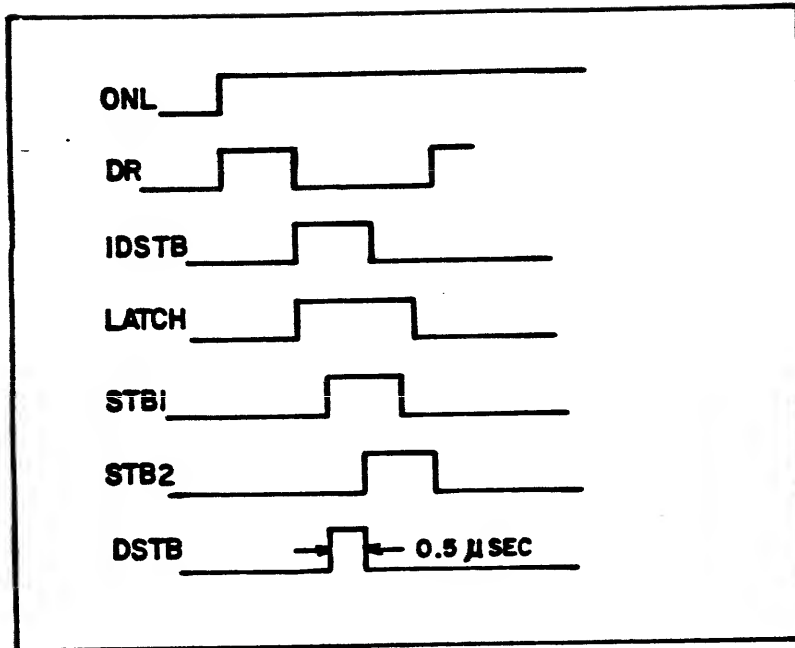


Figure 41 Data Products Interface Timing

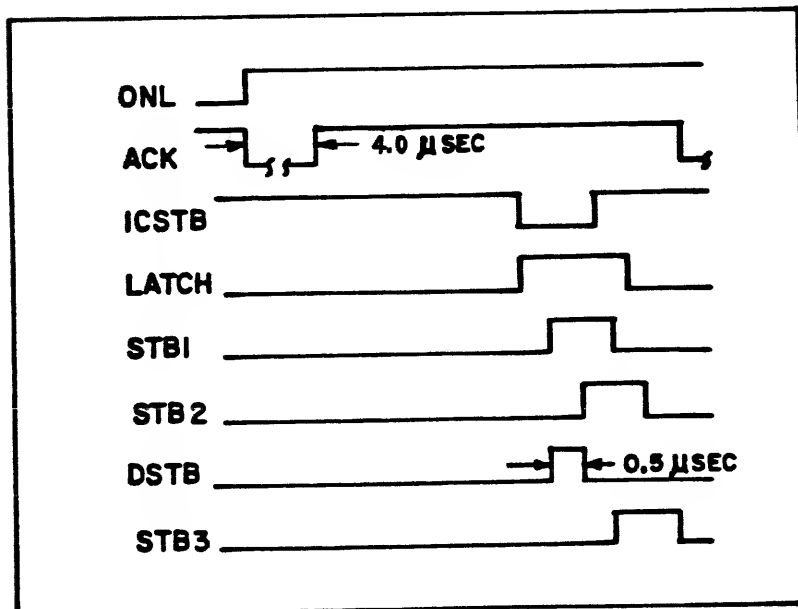
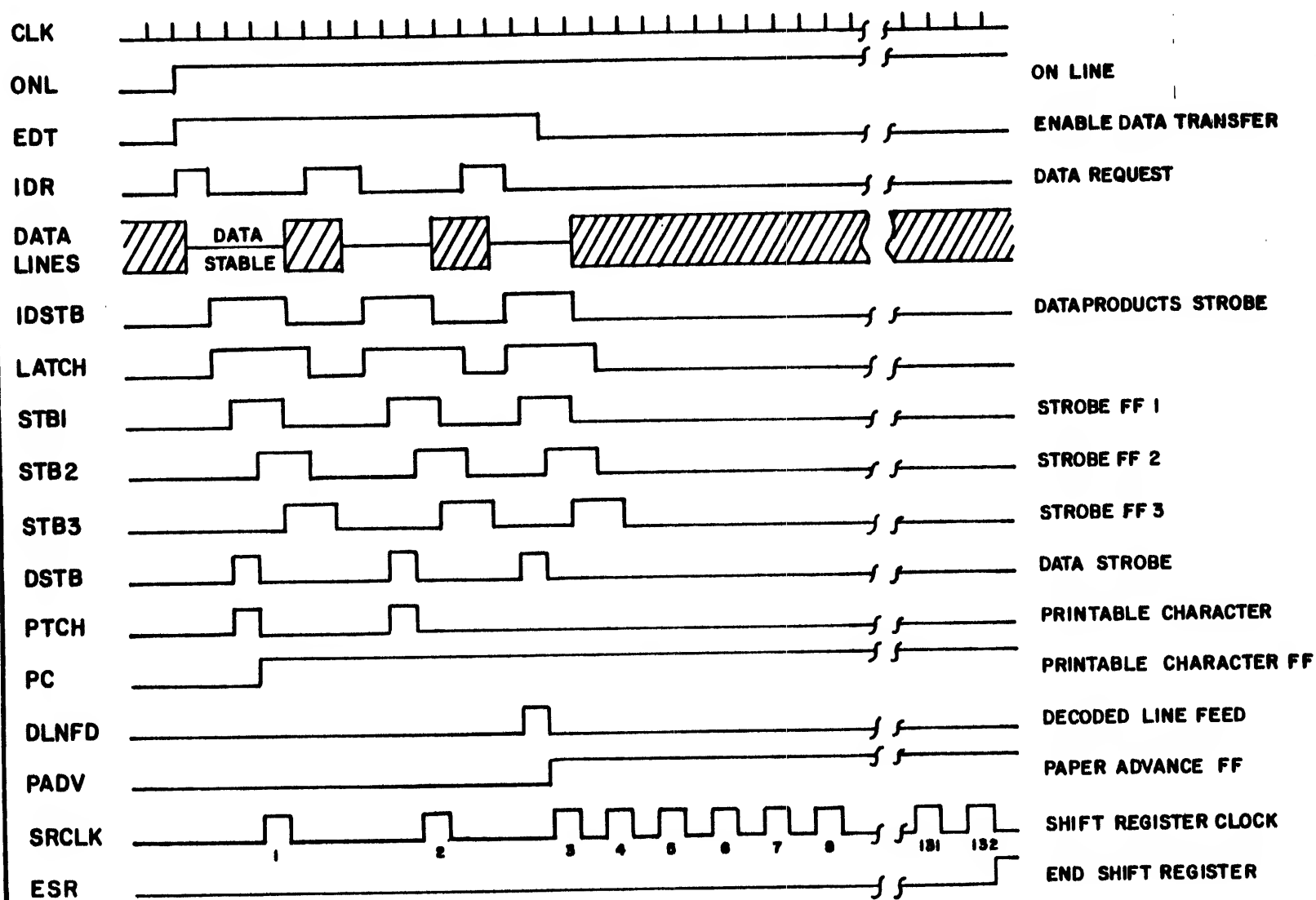


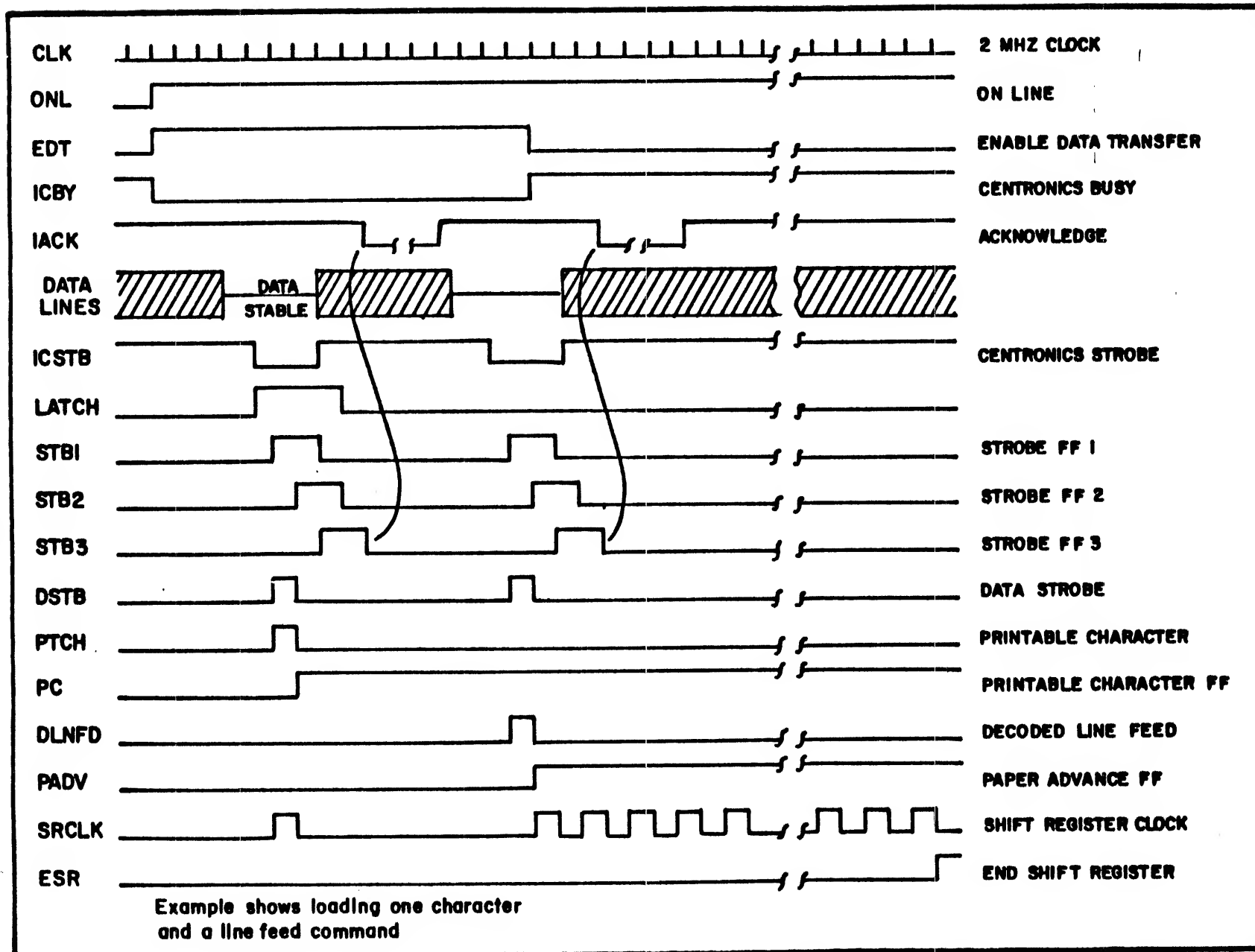
Figure 42 Centronics Interface Timing

Figure 43 Buffer Loading Timing, Data Products Interface



Example shows loading of two characters and a line feed command

Figure 44 Buffer Loading Timing, Centronics Interface



Strobe timing logic is clocked by the basic 2-MHz clock CLK and generates timing signals DSTB and NSTB3 from the strobe inputted to it while the flag is set. **Figures 43 and 44** show the timing of events during the Load Buffer State for Data Products and Centronics Logic.

Operation is essentially the same for a Centronics type controller except that the printer asserts IACK instead of IDR. IACK is generated by NSTB3 and reset in 4 microseconds.

2.34 THE SAFETY CIRCUITS

There are a number of possible circumstances that could either turn on coil current when it is unwanted or fail to turn off coil current after hammer release. This could cause coils and drivers to be damaged by overheating. The printer incorporates features which protect it from hammer coil circuit damage. These features all act by holding the OE signal low, disabling the tri-state buffers.

- a. When printer power is turned on, the OE flip flop is held reset until voltage levels have risen to acceptable levels. This prevents spurious triggering of print hammers.
- b. The +5V DC supply on the Hammer Driver PCBA is monitored. If the voltage rises above or falls below limits established by Zener diode avalanche levels, the OE flip flop is held reset.
- c. If the return (ground) circuit for the +36V DC supply is not connected to the Hammer Driver PCBA, the OE line is held reset.
- d. If the Hammer Reset (HRS) signal does not occur within one millisecond after OE becomes high, OE is forced low by the output of a retriggerable one shot. The one shot is continuously triggered by HRS and times out after one millisecond if it is not triggered.

2.35 THE ELECTRONIC VERTICAL FORMAT UNIT

The Electronic Vertical Format Unit (EVFU) increases the efficiency of the user's system by reducing the number of commands required when printing repetitive forms such as checks, invoices, etc. The EVFU permits printing forms having up to 132 lines with as many as fourteen discrete "stop location" codes within the form. A "slew" feature permits advancing paper up to 16 lines using a single command.

The three principal modes of EVFU operation are:

- a. Loading the EVFU memory with coded formatting information.
- b. Using the EVFU to seek the programmed "stop locations" when printing the form (Channel Seek mode).
- c. Advancing paper a number of lines, from one to 16, without regard to the contents of the EVFU memory (Binary Count mode, i.e. Data Products only).

2.36 LOADING THE EVFU MEMORY

The EVFU memory is a 4 bit recirculating shift register storing up to 132 channel numbers from 1 through 14 (**Figure 45**). The memory is loaded by the program in four steps, as follows:

- a. A Start Load Command (NSTL), is applied to the VFU Load flip flop. The flip flop is clocked by the Paper Instruction pulse (NSPI) and set to assert the signal LD. LD clears EVFU control logic and enables the EVFU memory to be blocked.
- b. The program then transmits to the EVFU memory (on data lines DB1 through DB4) the "simulate carriage tape" information to be loaded. Each 4 bit code is accompanied by a NSPI pulse which causes a NVSC clock. NVSC loads the code into the enabled IVFU memory. NSPI also increments the Memory Address Counter and SPI increments the Forms Length Counter.
- c. After the last channel code has been loaded, the program sends an End Load command (NELD), along with an NSPI pulse (**Figure 46**). This command has the following effects:
 1. The Load flip flop is reset, negating LD and returning the EVFU memory to its "recirculate" mode of operation.
 2. The TOP OF FORM indicator on the printer console is turned on (by EVR) to inform the operator that EVFU has been loaded.
 3. Further clocking of the Forms Length Counter is inhibited and the Memory Address Counter is permitted one additional count. (The Forms Length Counter always contains the binary count of the exact number of lines in the form.)
- d. The EVFU memory had a capacity of 132 lines of "simulated carriage tape" information. When a form of fewer lines is programmed, form information must be right justified (top to bottom of form) in the memory to prevent accessing the unused portion of the memory. Following the End Load operation (and each time the contents of the memory are accessed during Channel Search operation), the additional count of End Load character in the Memory Address Counter causes the 2-MHz clock rate to be divided by two, providing a 1-MHz clock which appears on the NVSC line. This high speed NVSC signal clocks the Memory Address Counter and the EVFU memory until the Memory Address Counter counts 132. This turns off the NVSC clock and stops the loading sequence.

2.37 CHANNEL SEEK MODE OPERATION

During the printing of a form, channel seek operation is performed to locate a specified channel number in the EVFU memory. In order for a Channel Seek operation to occur, the following conditions must be present (**Figure 47**):

- a. The program must put the binary number of the required channel on data lines DB1 through DB4.
- b. The required channel number must be loaded in the EVFU memory.
- c. The Paper Instruction line (PI) must be high. This may be either a decoded word from the program, or the logical line from a Data Products interface. The resulting NSPI signal (**Figure 43**) loads the 4 bit code into the data latches and sets the Vertical Format Slew signal (VFS). This signal causes paper feed logic to start paper movement as a Form Feed operation.

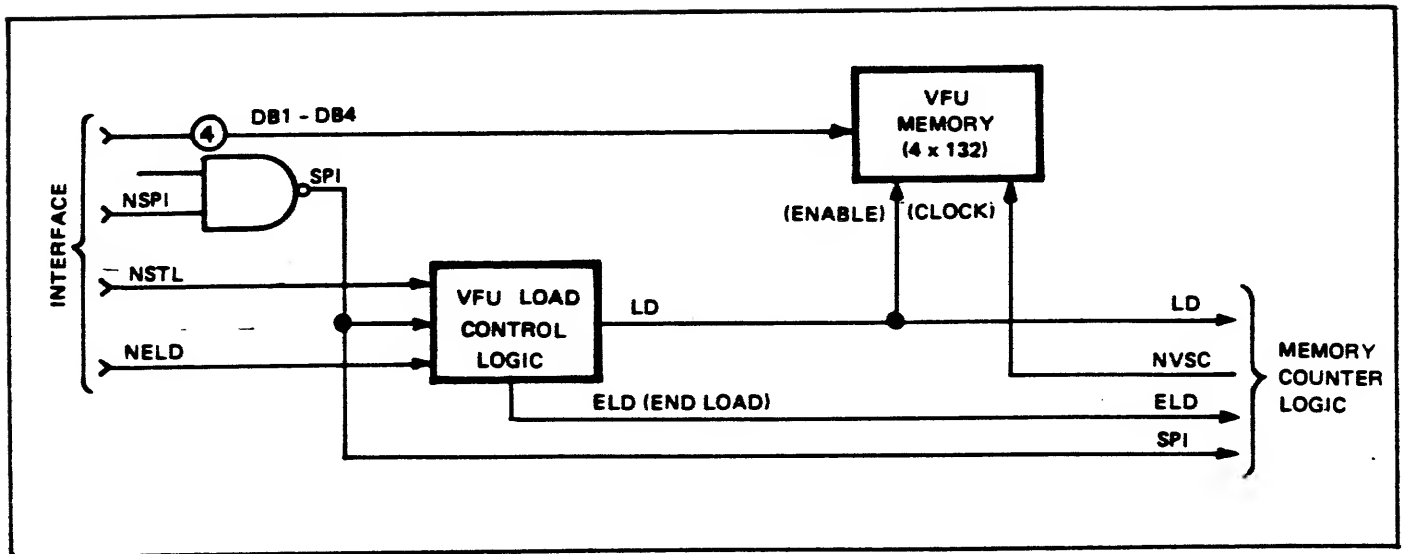


Figure 45 EVFU Loading Logic Functional Block Diagram

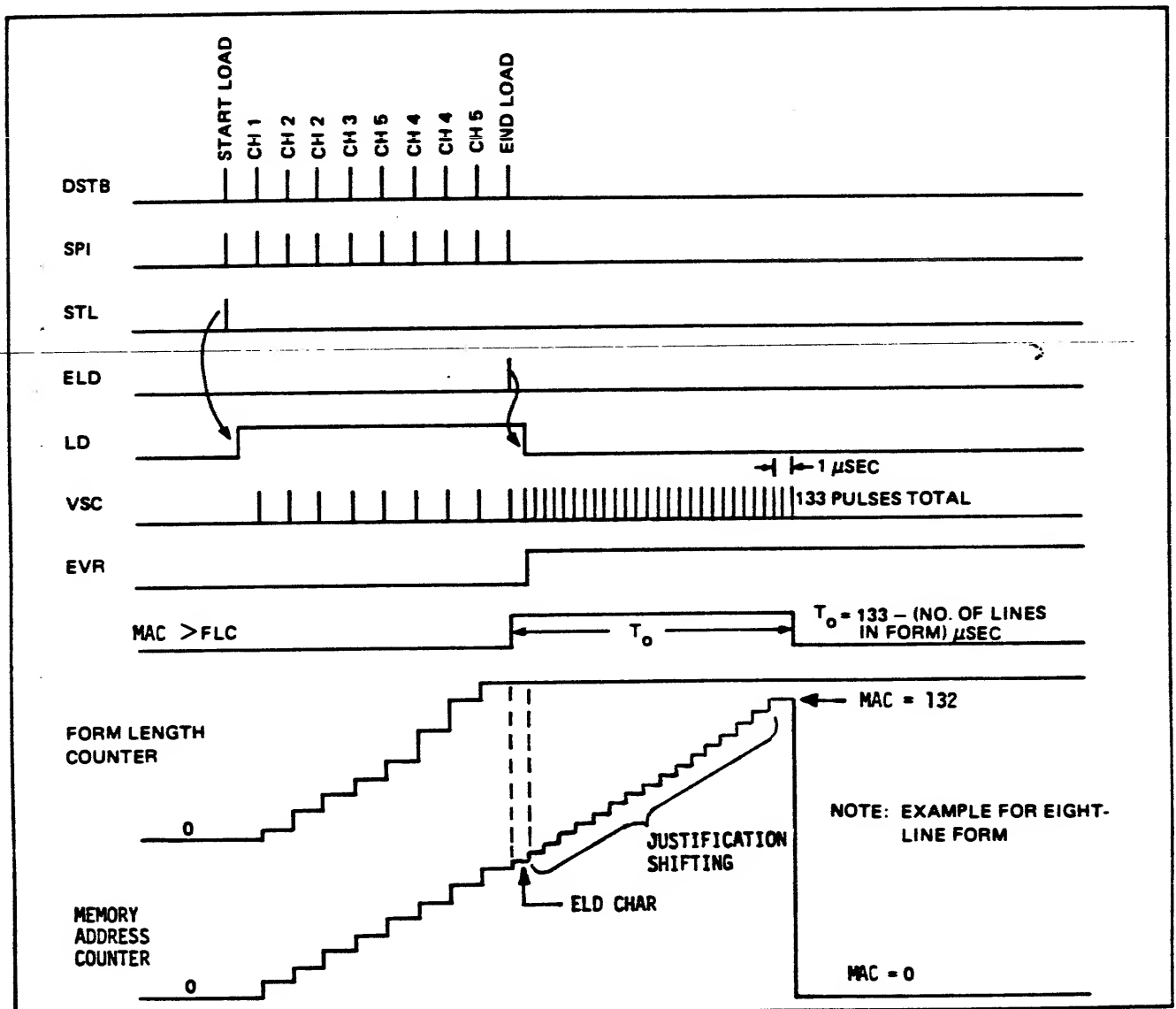
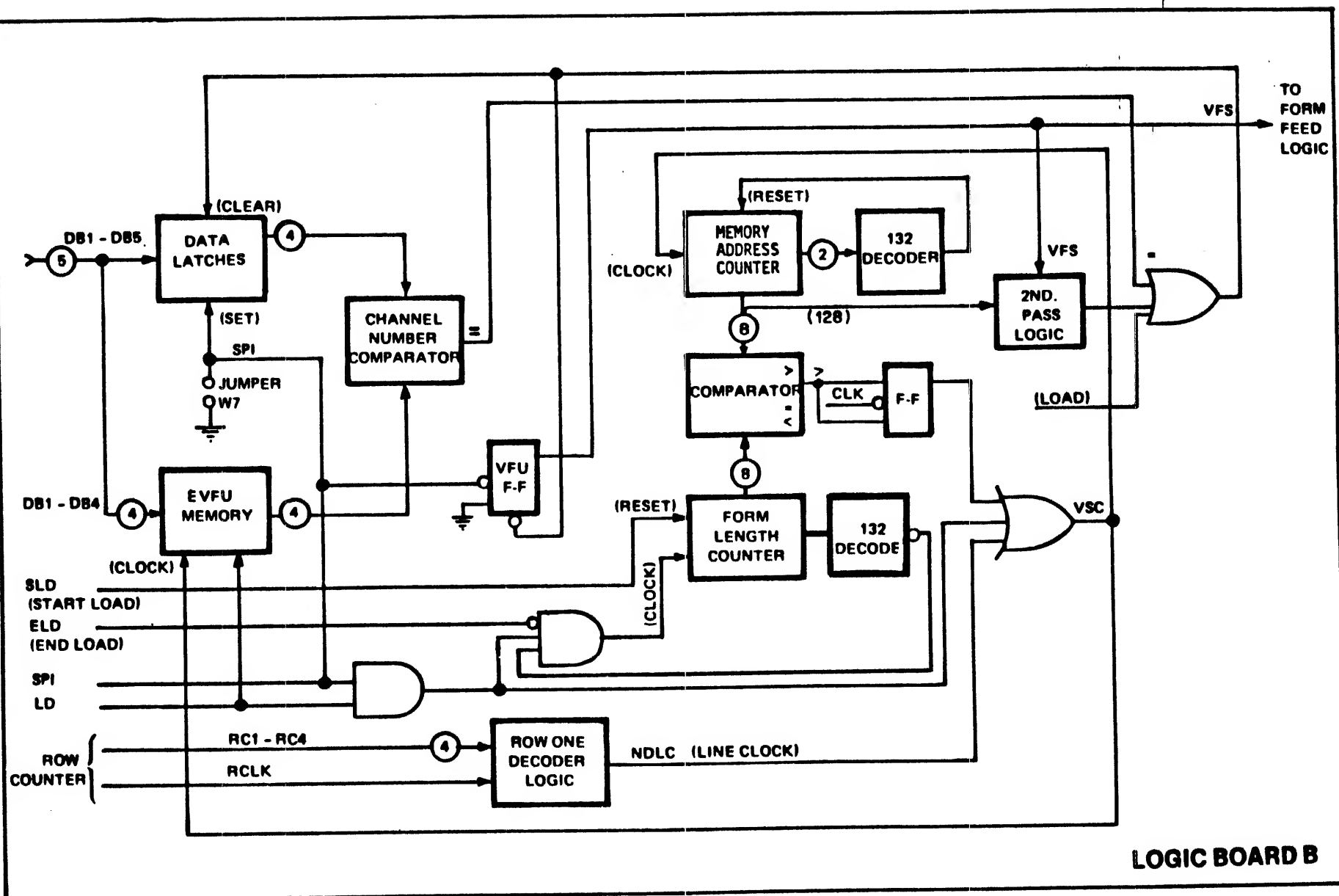


Figure 46 EVFU Loading Sequence Timing Diagram

Figure 47 Electronic VFU in Channel Seek Operation Functional Block Diagram



As paper advances through each line space, the row count recycles. This generates NDLC (Delayed Line Clock). NDLC appears at the VSC line. As a result the contents of the EVFU memory are stepped one address position to the right for each line of paper feed and appear at a comparator.

When the output of the EVFU memory matches the number in the data latches, both the data latches and the VFU flip flop are reset, stopping paper movement and ending the EVFU sequence.

Each time the EVFU memory is shifted, the Memory Address Counter is incremented. When the count in the Memory Address Counter becomes one greater than that in the Forms Length Counter, both the EVFU memory and the Memory Address Counter are clocked at high speed by VSC to again right justify the next contents of the EVFU memory.

Figure 48 shows the velocity profile produced by paper feed control logic during Channel Seek mode operation. The VFS signal generated by the EVFU configures the logic to generate this profile.

2.38 BINARY COUNT MODE OPERATION

In the Binary Count mode of operation the program may request that paper be slewed a specified number of lines (1 to 16) from the current position. Although this function is controlled by the EVFU, it is not necessary that the EVFU memory be loaded.

Conditions for this mode of operation are:

- a. Data bit DB5 must be high.
- b. Data bits DB1 through DB4 encode the number of lines to be slewed.
- c. The PI line must be high.

Figure 40 illustrates logic that controls the Binary Count mode of operation.

Bit 5 (NVB5) disables the Channel Seek comparator logic and enables the line count comparator. NSPI clocks the binary code into the data latches and sets the Vertical Format Slew (VFS) flip flop, causing paper feed logic to start paper movement.

As paper advances, a line counter is incremented by Row Count Reset (RCR) pulses. Each RCR marks the last dot row of a line space. When the line count matches the number stored in the data latches, the comparator "equal" output resets both the data latches and the VFS flip flop via a logic gate stopping further paper movement.

2.39 THE VERTICAL FORMATTING UNIT

The EVFU may be operated by a programmed VT code (013) which bypasses the PI line and causes an NSPI pulse to load vertical tab data (decimal 12) into the EVFU data latches. Because the code is always a channel 12 request, the EVFU slews paper until channel 12 is found in the EVFU memory. If a VT code is received and the EVFU memory has not been loaded, a single line feed results.

2.40 RUNAWAY PAPER FAULT PROTECTION

The EVFU protects the printer from paper runaway resulting from either of the following programming faults (Figure 49):

- a. The EVFU is commanded to seek a channel but the EVFU memory has not been loaded. — The paper advances one line, the VFS flip flop is reset and further paper movement is stopped.
- b. The EVFU has been loaded but the required channel code does not exist in memory. — The paper advances one line as the EVFU searches all memory locations for the non-existent code. When the next memory search reaches a count of 128, “2nd pass” logic simulates an “equals” condition in the comparator, which resets the VFS flip flop and stops further paper movement.

2.41 PROGRAM GENERATED PAPER INSTRUCTION

In systems not providing the logical PI signal at the interface, a program code may be used to perform the PI function. Conditions are as follows:

- a. Jumper W5 on the Logic A PCBA must be installed.
- b. Data bit DB5 must be high.
- c. Data bits DB6 and DB7 must be low.

NOTE

Binary Count mode is not available under these conditions.

2.42 DISABLING THE EVFU

The EVFU can be disabled by connecting jumper W7 in location 8K on the Logic B PCBA. That jumper disables NPSI so that the EVFU cannot operate.

2.43 THE POWER SUPPLY ASSEMBLY

The Power Supply Assembly consists of chassis mounted transformer/rectifier/filter circuits and the Power Supply PCBA.

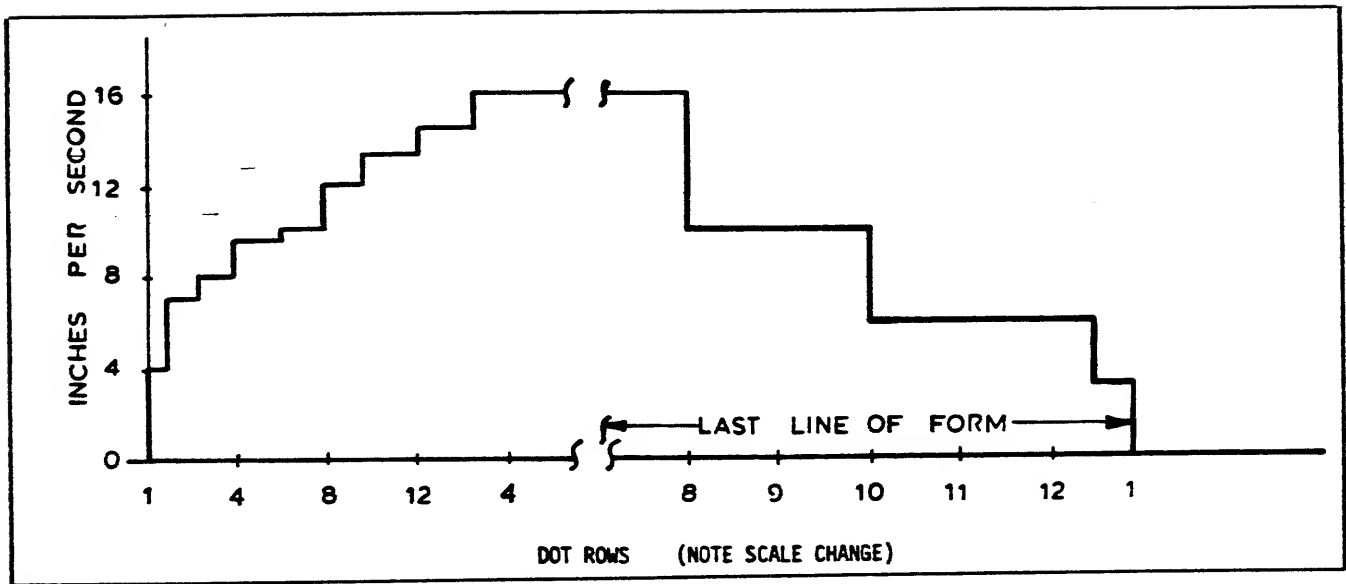


Figure 48 EVFU Channel Seek Operation Velocity Profile

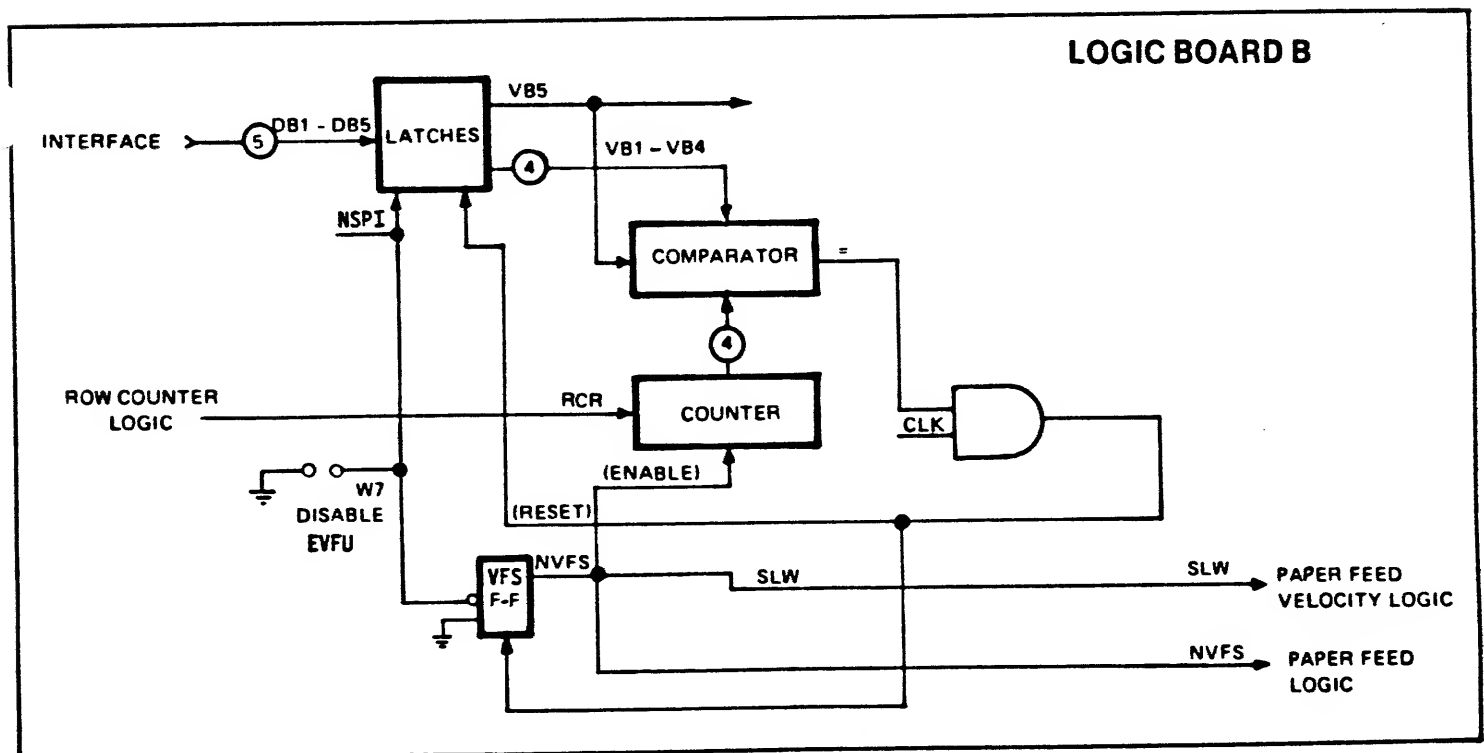


Figure 49 Electronic VFU in Binary Count Mode of Operation

2.44 THE TRANSFORMER/RECTIFIER/FILTER CIRCUITS

AC line power appears at the transformer through primary winding taps selected for the line voltage in use. Either one or both sides of the line are protected by a dual circuit breaker, depending on site line voltage. The circuit breaker is tripped when excessive current is drawn from the + 36V DC supply.

Secondary windings of the transformer provide AC voltages to provide the following outputs:

- a. 36V ACIN, which appears across each half of the center tapped secondary winding. This voltage from one of the halves is used to provide + 36C DC to Hammer Bank drive circuits and to supply + 70V DC (from across both transformer halves) to the Paper Feed drive circuits.
- b. + 9.5V DC Transformer output is rectified and filtered to + 9.5V DC. This voltage is applied to the reference voltage circuit and the Logic + 5V DC Supply, both located on the PCBA.
- c. - 33VDC Transformer output is rectified, filtered and unregulated to - 33V DC. This voltage is input to the - 12V DC voltage regulator on each of the printer PCBAs and to the Power Supply PCBA fault detection board.

2.45 THE POWER SUPPLY PCBA CIRCUITS

Power supply circuits on the Power Supply PCBA receive the AC and DC voltages from the rectifier/filter circuits, and produce regulated and unregulated DC voltages for various purposes within the printer.

Other circuits on the Power Supply PCBA include:

- a. The Paper Feed Disable Circuit
- b. The Magnetic Pickup Amplifier
- c. The Paper Feed Motor Drive Circuits
- d. The Paper Motion Detector
- e. The Paper Out Detector
- f. Safety Circuits

Paper Feed Motor Drive, Paper Motion Detector, Paper Out Detector and Safety Circuits are described earlier in this section of the manual.

2.46 THE REFERENCE VOLTAGE CIRCUIT

Filtered +9.5V DC enters the Power Supply PCBA through fuse F1 and appears at both the reference voltage circuit and the +5V DC regulator.

At the reference voltage circuit, the +9.5V input appears at a voltage regulator module which furnishes a regulated 2.6V DC output. This voltage is the reference for the +5V DC regulator and the -36V Fault circuit. It is also the input to a comparator amplifier which produces the 1.0V DC reference voltage, VREF.

The voltage VREF is the reference for the +36V DC regulator, the Paper Out Detector and the Paper Feed Enable (NPFD circuit).

2.47 THE +36V DC SUPPLY

The +36V regulator receives +36V AC (normal voltage) from across each half of the transformer secondary. This voltage is rectified by a half wave rectifier consisting of two SCRs. Each SCR controls the duration of current flow during one half cycle. The SCRs work together with a regulator circuit to maintain a relatively constant pulsating DC voltage at the SCR cathodes.

The SCR output (at Power Supply PCBA connector J9) is filtered by a choke and capacitor and supplied to the hammer bank drive circuits. The filtered +36V DC is also returned (through J10) to the PCBA. After it is fused by F3, it supplies power to other circuits on the board.

A comparator amplifier circuit switches off the SCRs when the wave form falls below the instantaneous regulated +36V level. The SCRs are again switched on during the next half cycle at the level determined by the comparator amplifier.

The comparator amplifier samples the regulated voltage and compares the sample with the 1.0V VREF level. The output of the circuit controls the SCR rectifier circuit through the circuit in location U17 and the optical coupler U15. The SCR in the optical coupler is used to insure that SCRs are turned on only at the zero crossover of the AC waveform, avoiding excessive switching currents.

2.48 THE +70V SUPPLY

A +70V DC source is required by paper feed drive circuits. This voltage is derived from the AC voltage across the two +36V AC lines, J11 and J15. The rectifier CR24/CR26 produces a pulsating +70V DC voltage which is filtered by a capacitor and then applied to the paper feed drive circuits on the Power Supply PCBA.

The unfiltered +70V DC appears at the optical coupler in the +36V DC regulator to provide zero crossing information and also references the +36V DC regulator amplifier via factory selected bias resistor R97.

2.49 THE +5V DC SUPPLY

The +5V DC logic voltage is derived from the +9.5V DC input (through fuse F1) to the Power Supply PCBA. This voltage appears at the emitter of series pass transistor Q16. The regulated +5V at the collector of Q16 is sampled by divider R107 and R109 and fed to amplifier U18, where it is compared with the regulated 2.6V level from the reference circuit. The sample of R107/R109 also controls the +5V regulator, U18/Q18.

The regulated +5V DC line supplies all TTL logic in the printer and controls generation of the Hammer Bank Master Clear signal (HMC). This signal prevents spurious hammer activation when power is turned on.

2.50 THE PCBA - 12V DC SUPPLY

The Power Supply PBCA and each PCBA in the printer card cage contain a voltage regulator module which receives -36V DC from the rectifier/filter circuits and provides -12V DC to MOS circuits on the PCBA.

2.51 THE PAPER FEED DISABLE CIRCUIT

This circuit controls switching of +36V DC switched voltage (VSW) to paper feed circuits, generates the Paper Feed Disable signal NPFD, and supplies +36V DC to a +12V DC regulator on the board.

VSW is derived from the regulated +36V DC line. Amplifier U16 is switched by the Paper Drive Enable signal (NPDE) to produce the output NPFD. NPFD turns off the paper feed drive circuits directly, and also switches off the VSW voltage.

2.52 THE MAGNETIC PICKUP AMPLIFIER

This linear amplifier circuit amplifies the low level AC signal from the magnetic pickup and transmits it as a TTL level digital signal, to print synchronizing circuits on the Logic B PCBA.

Typical signal levels received from the magnetic pickup are as follows:

- a. SYNC: 2.0V to 3.5V peak to peak.
- b. RESYNC: 4V to 6V peak to peak.

The amplifier circuit provides hysteresis feedback with input bias set to +2.7V DC.

PREVENTIVE MAINTENANCE

3.1 GENERAL

This section contains information and instruction for performing preventive maintenance of the printer. The performance and lifespan of the printer depend on regular preventive maintenance, especially cleaning, lubrication, and belt tension adjustment. If the printer is operated with the front cover closed, little environmental dust will be accumulated within the printer. However, ribbon lint, paper dust and chaff will build up and could eventually interfere with machine performance and print quality if not periodically removed.

Perform preventive maintenance procedures every six months or following every 500 hours of operation. More or less frequent intervals might be necessary, depending on site conditions and printing applications.

3.2 CLEANING THE EXTERIOR

Operating personnel are expected to keep the printer exterior clean. Clean the printer exterior using a soft cloth and detergent. Do not use abrasives, especially on the printer window.

3.3 CLEANING THE INTERIOR

Vacuum the printer interior to prevent a gross buildup of paper dust and chaff, ribbon lint and debris, and ink.

Besides a general cleaning of the printer interior, additional cleaning may be required at the following points:

- The Ribbon Guide.
- The Paper Feed Mechanism.
- The Paper Motion Sensor Assembly.
- The Hammer Bank Assembly.

3.4 CLEANING THE RIBBON GUIDES

After an extended period of operation, ink buildup on the ribbon guides (**Figure 50**) may become sticky and interfere with smooth ribbon movement. To clean the ribbon guides, remove the accumulated ink from the guides with a cloth dampened with isopropyl alcohol.

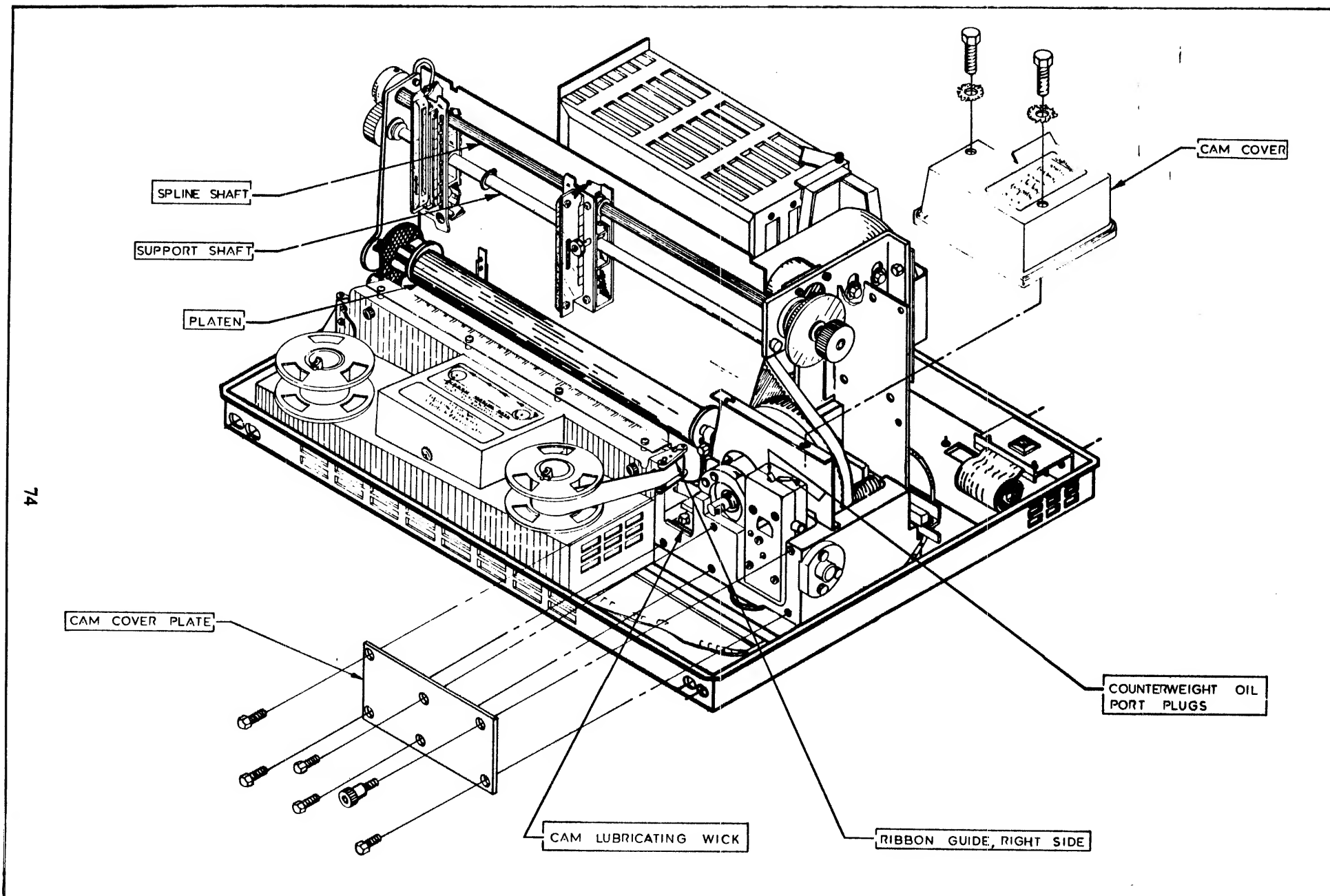


Figure 50 Printer Lubrication Points and Paper Transport

3.5 CLEANING THE PAPER FEED MECHANISM

Clean accumulated paper dust and debris from the platen shaft and from the spline shaft and support shaft, **(Figure 50)** where it may stick to lubricated surfaces. Wipe off the surfaces with a cloth, removing excessive grease along with debris.

A reapplication of a thin film of grease to the shafts will assist tractor positioning if the above procedure has removed the original coating. Be sure the surfaces are clean before applying grease.

3.6 CLEANING THE PAPER MOTION SENSOR ASSEMBLY

The Paper Motion Sensor Assembly is located at the bottom of the left-hand tractor and is visible when the tractor's paper gate is open. Periodically clean both sensor apertures using a soft bristle brush to remove accumulated dust and paper debris **(Figure 51)**. A dirty sensor may be indicated by the CHECK light turning on during a paper motion operation.

NOTE

The Paper Motion Sensor Assembly need not be removed during cleaning.

3.7 CLEANING THE HAMMER BANK ASSEMBLY

Unless periodically cleaned, the Hammer Bank Assembly will accumulate enough ribbon lint and paper dust to eventually impair print quality.

To clean the hammer bank, proceed as follows:

- a. Turn off the AC power.
- b. Set the Forms Thickness Adjustment lever to the LOAD position and remove the paper.
- c. Remove the Ribbon Drive Assembly as follows:
 1. Remove the retaining screws going into the bearing blocks.
 2. Mount the assembly on the cam plate shoulder screw **(Figure 80)**.
 3. Vacuum the blower filter.

- d. Loosen the two comb bracket retaining screws and raise the comb bracket free of the screws.
- e. Carefully disconnect the four coil wire connectors.
- f. Remove the anti-rotation arm as follows:
 - 1. Move the comb bracket upward and remove the two screws holding the anti-rotation arm.
 - 2. Manipulate the anti-rotation arm clear of the front tension spring and then out of the shuttle frame.
- g. Loosen the bearing clamp bolts at the front of each bearing block.
- h. Force the Hammer Bank Assembly slightly to the left (to avoid damage to the Hammer Bank Cover Assembly) and rotate the Hammer Bank Assembly into the service position (toward the front of the printer).
- i. Carefully remove the Hammer Bank Cover Assembly from the Hammer Bank Assembly (**Figure 87**). **DO NOT BEND** the cover at the positioning pins and **DO NOT DAMAGE** the hammer tips.
- j. Use a stiff bristle brush to clean hammer tips and springs and to remove ribbon lint and paper dust. Heavy accumulations may be removed with a Kimwipe equivalent or a shop cloth lightly dampened in isopropyl alcohol.

CAUTION

Use of too much alcohol may damage the hammer coils.

- k. Remove loosened debris, wiping the hammer tips clean with a cotton swab. Be sure to eliminate any lint or wisps of cleaning materials.
- l. Clean the disassembled parts as necessary.
- m. Rotate the hammer bank back to its normal operating position.
- n. Replace the anti-rotation arm. Replace its two screws and torque them to 12 inch pounds.
- o. Reconnect the four wire connectors so no male pins are visible.
- p. Engage the comb bracket slots into their screws and tighten the screws.
- q. Adjust the hammer bank position as follows:

1. Turn on AC power and press the ON LINE switch to begin shuttling action. Recycle the ON LINE switch to continue the shuttling action.
 2. While shuttling, torque the bearing clamp bolts to 36 inch pounds.
- r. Verify the hammer tip to platen gap is 0.012 inches at both ends of the platen. Adjust the platen positioning screws if necessary.
- s. Replace the Ribbon Drive Assembly to its normal position. Install and tighten the screws into the bearing blocks.

3.8 LUBRICATION

Only two points on the printer require lubrication, the cam and the counterweight (**Figure 50**). Do not over lubricate either point; trouble free printer operation and maintenance are better assured by less oil, rather than more.

3.9 LUBRICATING THE CAM

The cam rotates over an oil saturated wick and picks up oil with each revolution of the flywheel. The cam may become galled and worn if permitted to run dry. To check and perform cam lubrication proceed as follows:

- a. Remove the cam cover (see **Cam Cover Caution below**) and gasket. Then check for oil film on the cam surface.

CAM COVER CAUTION

The star washers used under the cam cover retaining screws may leave some loose metal chips on the cover. Before removing the cover, carefully wipe off any loose chips to prevent them from getting into the cam area.

- b. Press a pen or narrow tool down into the wick between the hammer bank cam follower and the end of the yoke. If the tool does not pick up some oil from the wick, or if oil does not appear on the surface of the wick, slowly apply medium weight oil (SAE 20 or equivalent) until the wick is barely saturated.
- c. Replace the cam cover and gasket.

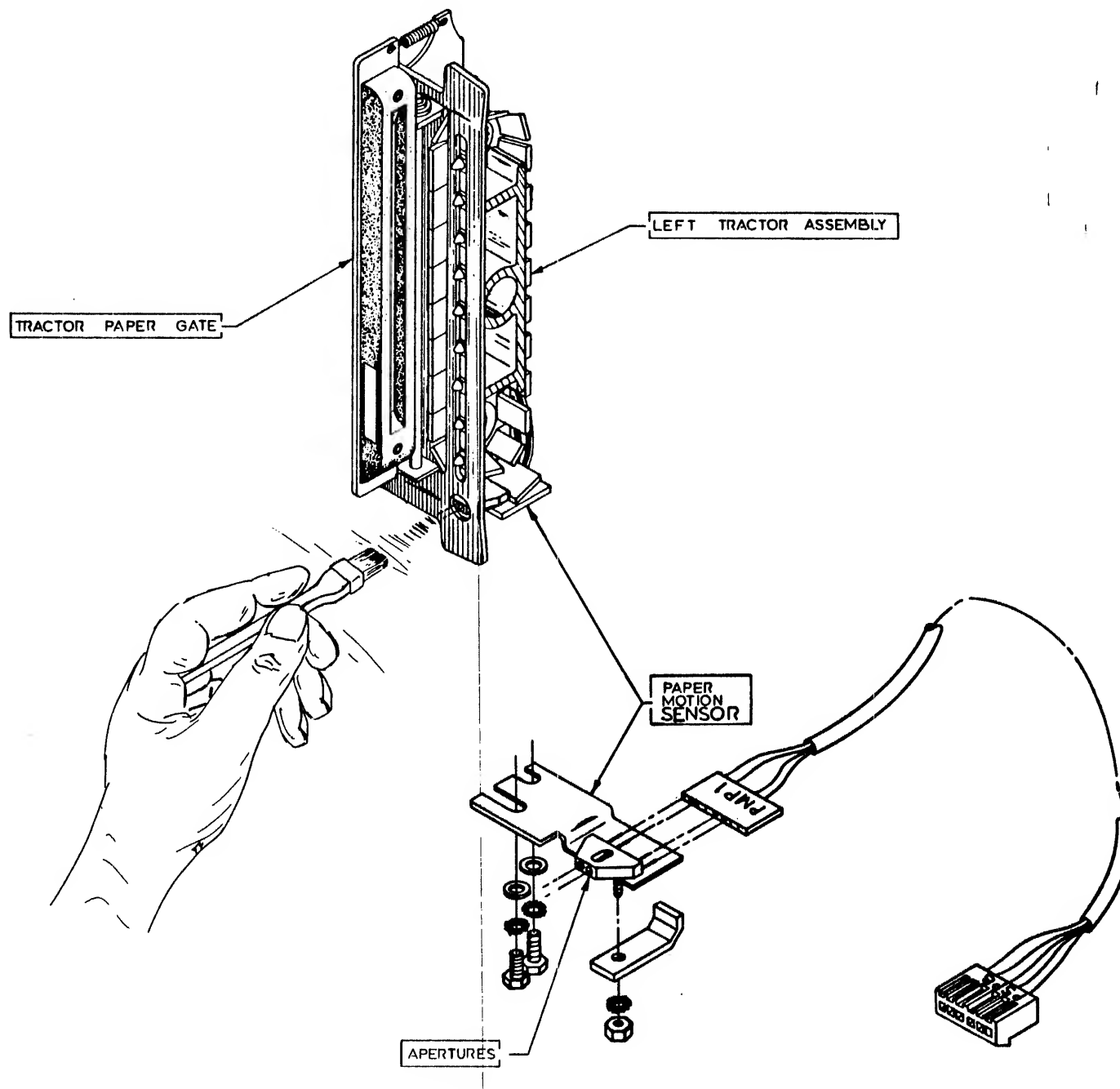


Figure 51 **Cleaning the Paper Motion Sensor**

3.10 LUBRICATING THE COUNTERWEIGHT

The counterweight has two oil ports; each contains a wick and is closed by a plastic plug. To lubricate the counterweight, proceed as follows:

- a. Remove the cam cover, (see **Cam Cover Caution**) then pull out the plastic plugs from the counterweight oil ports.
- b. Pour a few drops of medium weight motor oil (SAE 20 or equivalent) in each port. Replace the plastic plugs in the oil ports.
- c. Replace the cam cover and gasket.

3.11 CHECKING SHUTTLE BELT TENSION

Periodically check shuttle belt tension, as a loose belt may cause what appears to be random malfunctions.

To check shuttle belt tension (**Figure 52**) proceed as follows:

- a. Remove the screws and washers holding the cam cover, (see **Cam Cover Caution**) then remove the cam cover and its gasket.
- b. Press down against the belt, midway between the pulleys. The belt should appear taut but should deflect approximately 1/4 inch under some finger pressure.
- c. If tension is not adequate, perform adjustment procedures per **Section 5, subsection 5.20**.
- d. When tension is correct, replace the cam cover and gasket.

3.12 CHECKING PAPER FEED BELT TENSION

Incorrect paper feed belt tension can lead to excessive wear of the paper feeding mechanism, shortened belt life, damage the paper feed motor bearings and cause poor print quality.

To check tension:

Depress the upper span of the belt with a finger at approximately the mid point between the pulleys and observe 1/16 inch deflection of the belt at that point (**Figure 53**). In general, the belt will seem to be very tight when properly tensioned. If the belt is too tight, it will result in compressed printing due to severe friction in the feeding of paper. Ease the tension until the printing is normal.

NOTE

Only the black (Kevlar) belt (P/N 103188) is recommended for the P600.

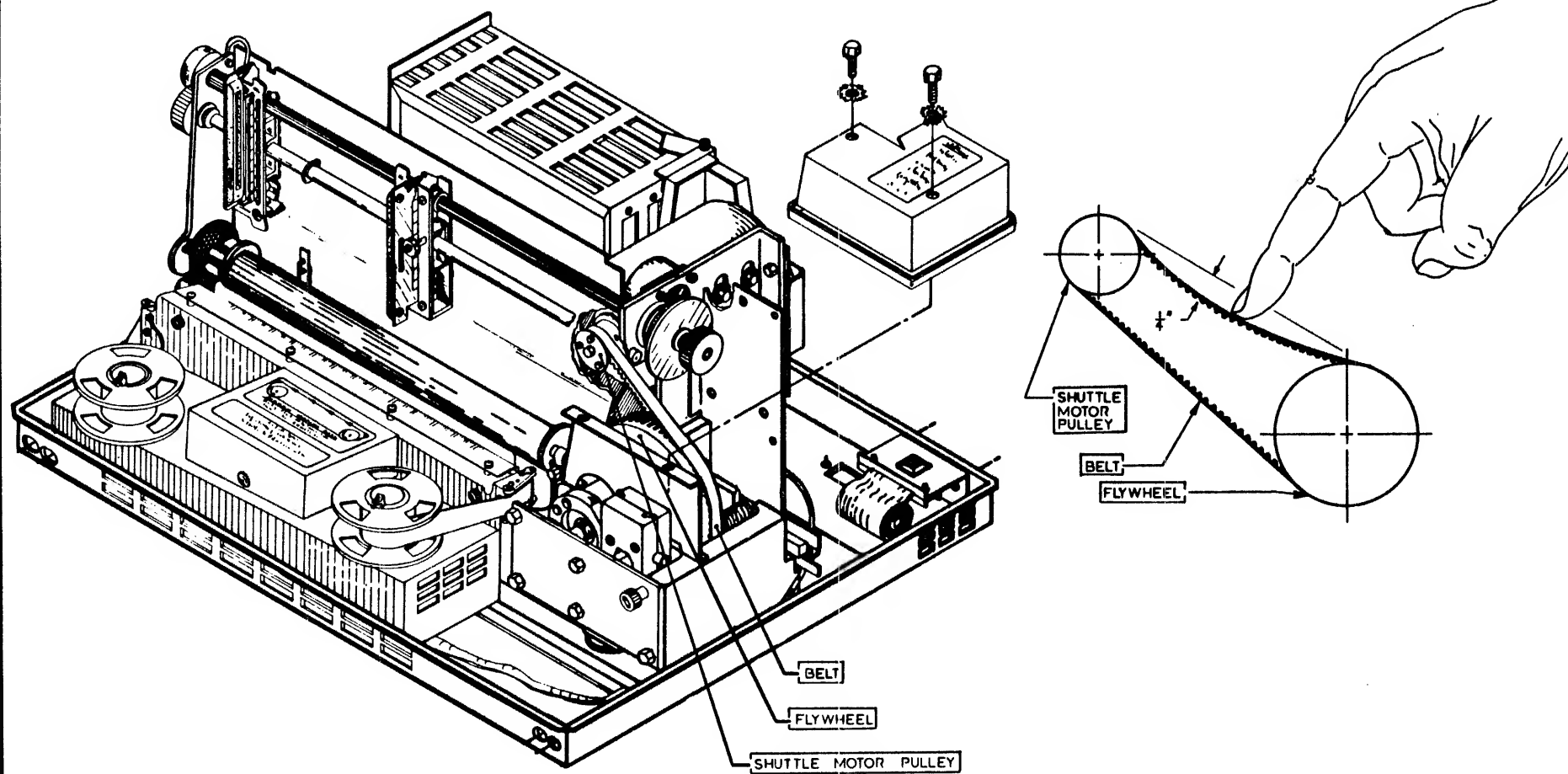


Figure 52 **Checking Shuttle Belt Tension**

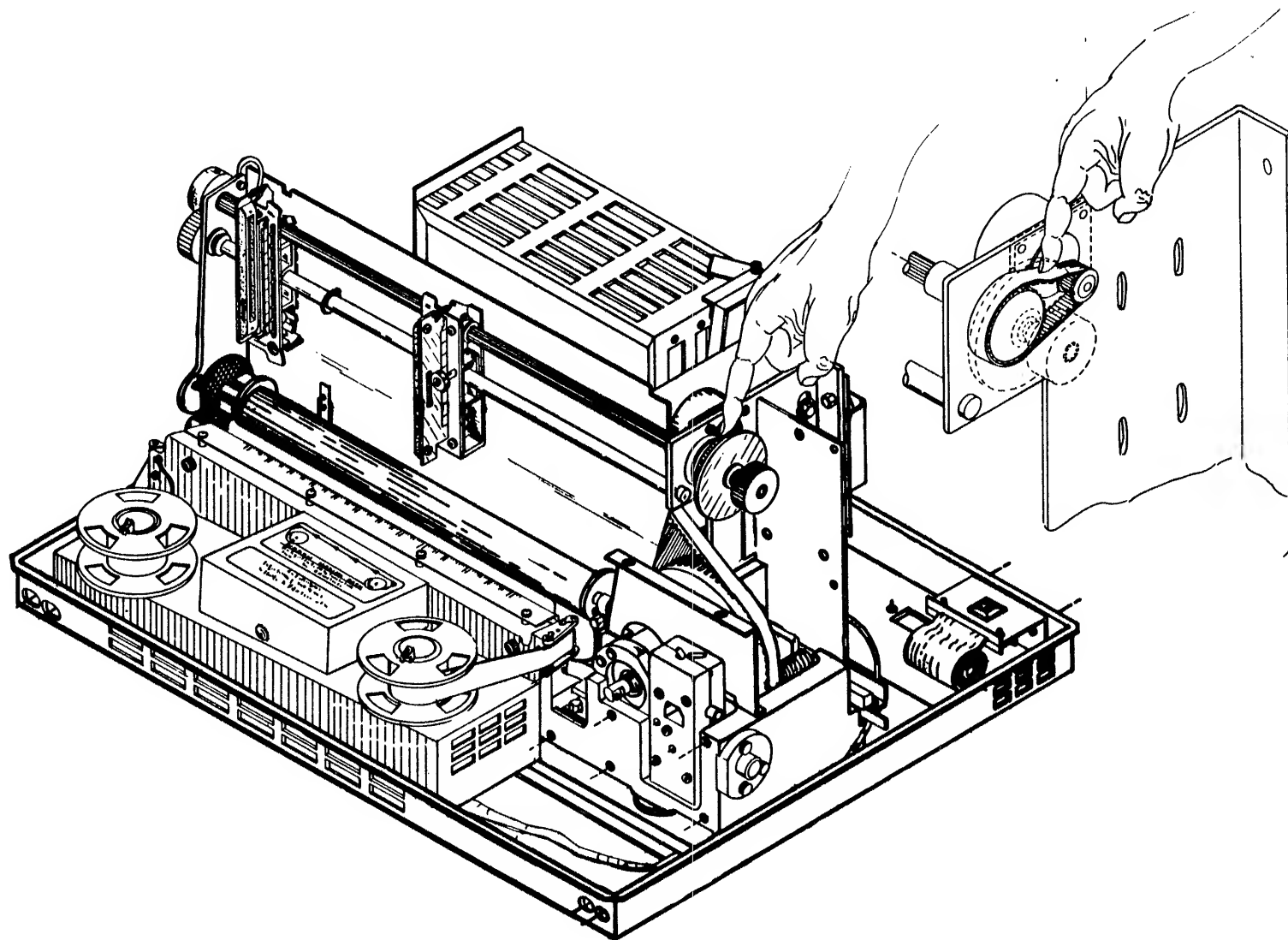


Figure 53 **Checking Paper Feed Belt Tension**

CORRECTIVE MAINTENANCE

4.1 GENERAL

Corrective maintenance includes locating the cause of the malfunction and repairing it. The maintenance technician should be thoroughly familiar with the contents of the Printronix Operator's Manual, the Printronix P600 Applications Manual, and the Theory Of Operation presented in **Section 2** of this manual.

Refer to the List of Illustrations in the Table of Contents of this manual and to logic, schematic, and wiring diagrams contained in the P600 Drawing Manual (P/N 105485).

In general, onsite (field) mechanical repair consists of performing procedures outlined in **Section 5**, Adjustment, Removal, and Replacement Procedures. Electronic failures are repaired by the replacement of the affected PCBA.

At depot level, fault isolating of the failed assembly determines the cause of failure; the failed component is replaced and the assembly is made available for further service. This type of service is beyond the scope of this manual and is best performed by the local distributor/supplier or Printronix, Inc.

Following completion of any repair, be sure to perform routing Performance Tests outlined in subsections 4.18 through 4.23.

4.2 FAULT ISOLATION/TOOLS REQUIRED

Information in the following section will aid the technician to isolate the cause of a malfunction to a specific subassembly or major component. **Figure 54** shows a block diagram of the printer components and the principal printer functions they perform.

By referring to the operations listed in the blocks for each PCBA (**Figure 54**), the PCBA elements contributing to failures can be recognized. Many operations are interdependent so more than one PCBA may be involved. Isolation of the problem is usually achieved by a single PCBA substitution; however, a mechanical problem will require more exact analysis.

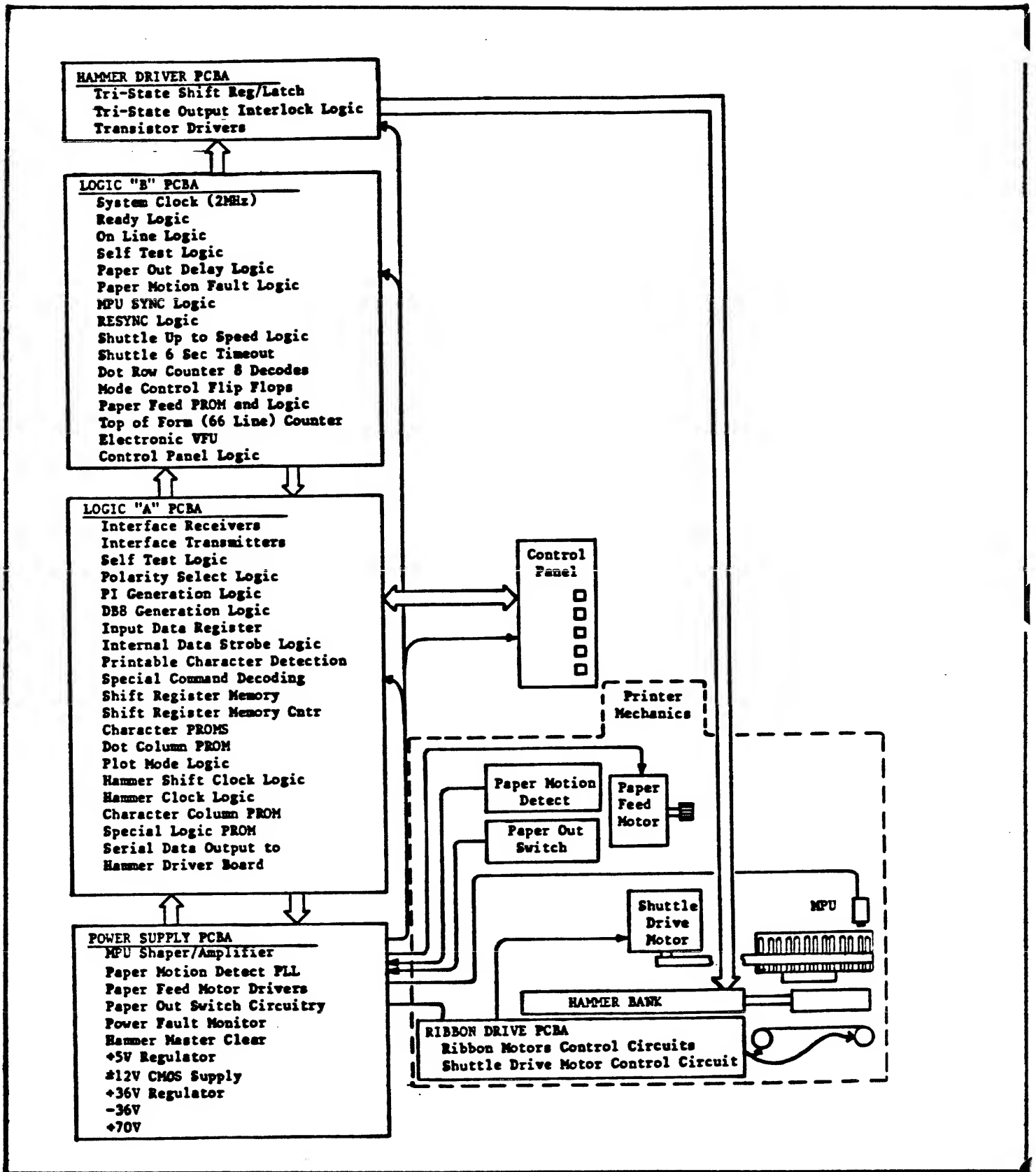


Figure 54 Printer Function Circuit Locations

TOOLS REQUIRED

The following tools are recommended support for maintenance of the P600 printer (Table 4):

TABLE 4 - Recommended Tools

Item No.	Item	Printronix No.	(Suggested) Mfg. No.
1.	Hammer Tip Alignment Tool - (Short)	103085-001	P600
2.	Exerciser	101635-001	-
3.	Exerciser Cable Data Products	101491-001	-
4.	Exerciser Cable Centronic	101507-001	-
5.	Extender, PCBA	101250-001	-
6.	Screwdriver, Torque 12 - 36 in. lbs adjustable	-	Utica TS35
7.	Screwdriver, Torque Adapter	-	Utica HW-18
8.	Screwdriver, Torque Hex Socket 3/16"	-	Utica W-8
9.	Screwdriver, Torque Hex Adapter 3/32"	-	Utica HW-4
10.	Screwdriver, Torque Hex Adapter 5/32"	-	Utica HW-6
11.	Crescent Wrench	-	Utica 91-4C
12.	Screwdriver, Allen Hex	-	Xcelite 99PS40
13.	Screwdriver, Phillips	-	Xcelite X100
14.	Screwdriver, Phillips	-	Xcelite X102
15.	Screwdriver, Slot	-	Xcelite A184
16.	Screwdriver, Slot	-	Xcelite R3164
17.	Nut Driver Set	-	Xcelite PS120
18.	Diagonal Cutters	-	Erem 91EH
19.	Pliers, Chain Nose	-	Erem 11DH
20.	Rule, Steel 6"	-	General 616
21.	Feeler Gauge Set	-	Pronto 000AA
22.	Pliers Grip Ring	-	Truarc 1120
23.	Tool, Lamp Removal	102386-001	-
24.	Soldering Iron and Tips	-	-
25.	Ratchet, 3/8" Drive	-	-
26.	Extension 3", 3/8 Drive	-	-
27.	Socket 7/16", 3/8 Drive	-	-
28.	Exacto Knife and Blades	-	-
29.	Digital Voltmeter	-	-
30.	Oscilloscope and Probes (35 MHz or better)	-	-
31.	Tool Case	-	-

Tools with Printronix part numbers are available from Printronix only. The other tools are available from the listed manufacturers and are included for reference.

4.3 PRINTER PREPARATION AND THE OPERATIONAL FLOW CHART

Figure 55 is a flow chart of operations to be performed on the printer with the aid of an exerciser. In the flow chart, a rectangle represents an action to be taken. A diamond indicates an expected event that did or did not happen as a result of the action. If the event did not happen, there is a failure.

In general, a failure is related to paper feed, printing action or ribbon control. Figures 56, 57 and 58 are flow charts for these respective problem areas. They follow the same rules as Figure 55 and are interconnected to it at circled letters A, B and C.

When seeking the cause of the failure, first check the related connectors and disconnects to be sure they are secure. Next check the DC voltage on the Power Supply PCBA. Then do the operation in the NO branch of the expected event diamond which represents the symptom of failure.

4.4 FAILURE TO OPERATE ON INITIAL TURN ON

Failure of a new printer to operate correctly when it is first put into service is often the result of an incorrect configuration in PCBA Jumpers, termination resistors, and PROMs on the PCBAs. Configure the boards for operation in the P600. Also configure for a particular interface (Data Products or Centronics) and for any optional printer function.

If the printer does not operate correctly on initial turn on or following installation of a replacement PCBA, check configurations defined in the Printronix Applications Manual. Determine that those configurations are correct.

4.5 THE INTERFACE

Figure 15 (Section 2) shows a block diagram of the printer/controller interface. Use an exerciser to determine that the data lines and strobes are changing state at the receiver outputs and that the driver outputs are returning status information to the controller.

4.6 PAPER FEED INITIATION AND TROUBLESHOOTING

Events that initiate paper feed are:

- a. An input Line Feed or Form Feed command received during the Load State operation.
- b. A full row count (7 or 9) after a line of characters has been completed.
- c. Actuation of the Form Feed or Paper Advance pushbutton.
- d. Arrival of paper at the selected skip over perforation line.
- e. An input binary number, Vertical Tab command, or EVFU channel number (in the data lines), along with a Paper Instruction (PI) signal (standard interface). This will cause paper to slew a specified number of lines.

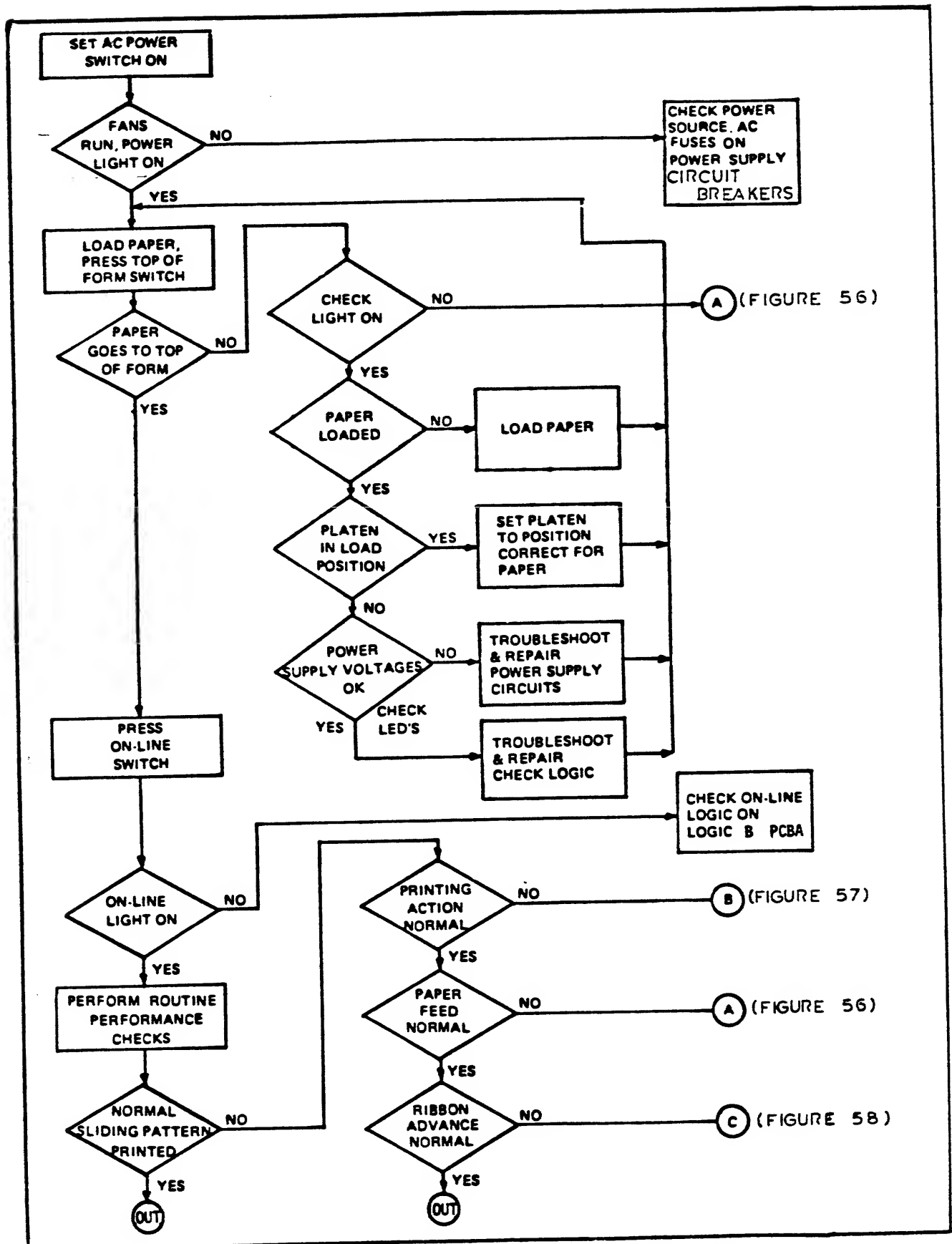


Figure 55 Printer Preparation and Operation Checks Flow Chart

The Paper Feed flow chart (**Figure 56**) provides information helpful in isolating faults in the paper feed circuits.

4.7– PRINT MODE OPERATION AND TROUBLESHOOTING

Events that cause printing include the following:

- a. Reception and storage of data in the interface.
- b. Positioning of the shuttle mechanism in coordination with SYNC and RESYNC information supplied by the magnetic pick-up circuits.
- c. Correct sequences of reading character input from the buffer memory for dot column, dot row, and character count.
- d. Correct translation of character codes into serial bits and multiplexing these bits to the hammer drivers via the COM Line.
- e. Correct operation and timing of Hammer Driver PCBA shift registers, data latches, tri-state buffers and Darlington drivers's.
- f. Correct operation of hammer bank coils and print hammers.

A thorough understanding of the Theory Of Operation of the printing process is necessary for efficient troubleshooting of printing action.

Figure 57 is a flow chart to aid in identifying events in the print sequence.

4.8 TROUBLESHOOTING THE RIBBON DRIVE

The shuttle motor and the ribbon drive motors are controlled by the same signal, Shuttle Drive (NSD). If the shuttle motor runs normally, but the ribbon does not move, the problem may be assumed to lie in the Ribbon Drive Assembly.

Power is switched (by NSD) to the shuttle motor through a triac on the Ribbon Control PCBA. If neither the shuttle motor nor the ribbon drive motors operate, check connections on the PCBA. Then check the NSD circuits on the Logic B PCBA.

NSD is an active low signal. Therefore, a fast check on the NSD signal may be performed by grounding the NSD output (5A pin 8 or J2 pin 3) on the Logic B PCBA. If the motors start, the fault is in the Logic B PCBA.

If the motors do not start, mount the Ribbon Drive Assembly in the service position as per **Section 5**, subsection 5.7. Connect ground to Z2, pin 2, of the Ribbon Control PCBA. If the motors start, check the connectors and cabling. If the motors do not start, replace the Ribbon Drive PCBA per **Section 5**, subsection 5.9.

Figure 58 is the flow chart for troubleshooting ribbon control circuits.

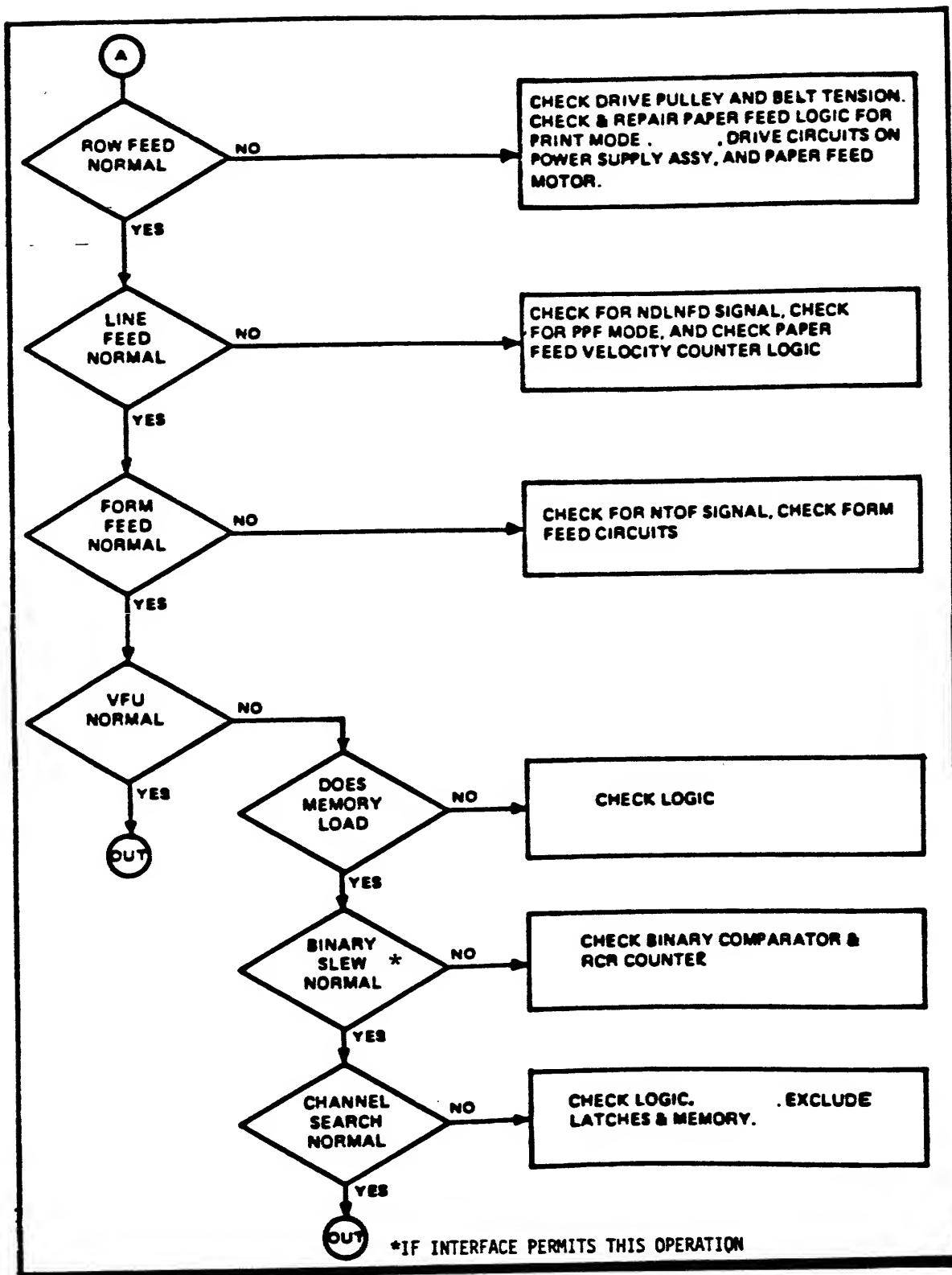


Figure 56 Paper Feed Logic Flow Chart

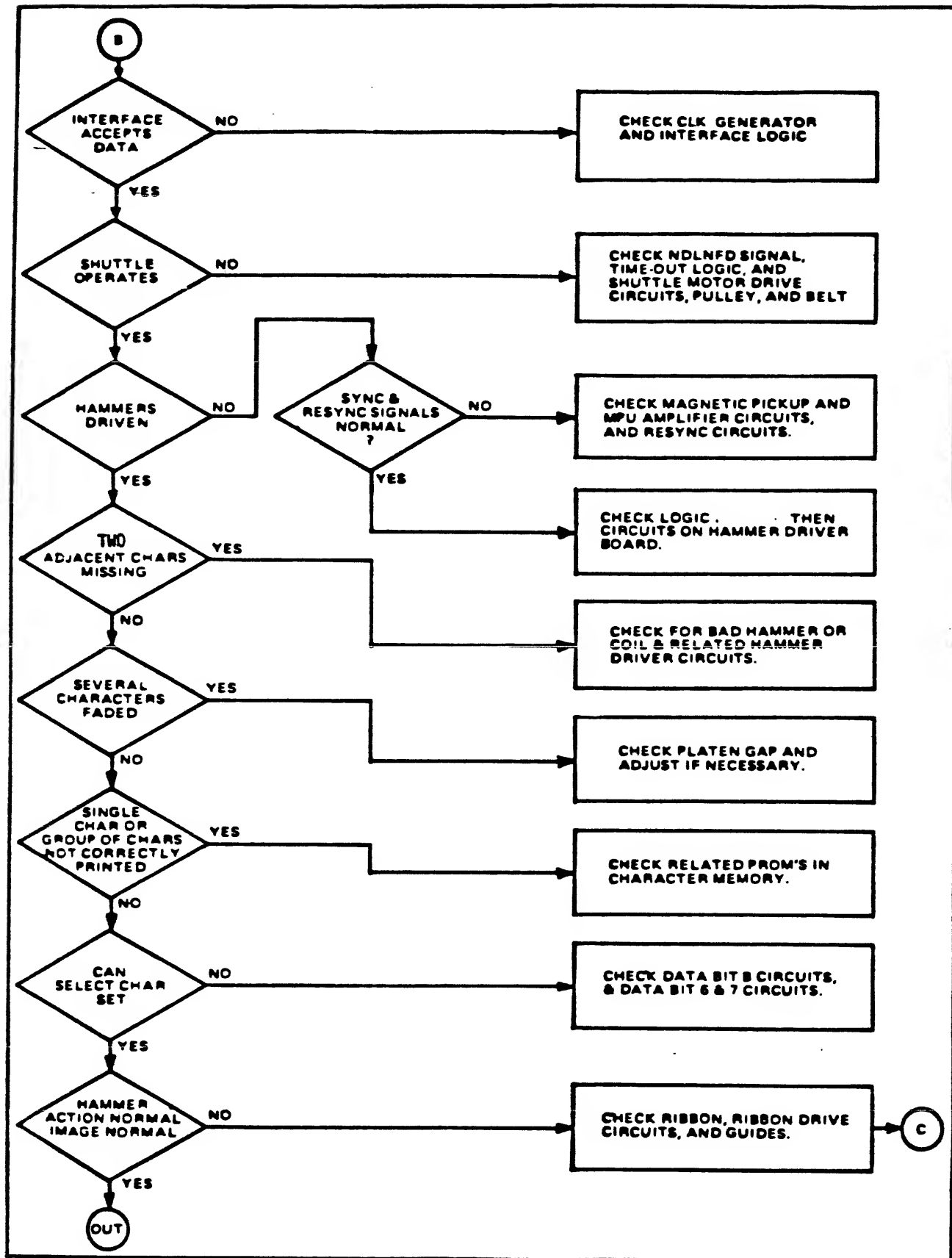


Figure 57 Logic and Mechanisms for Printing Action Block Diagram

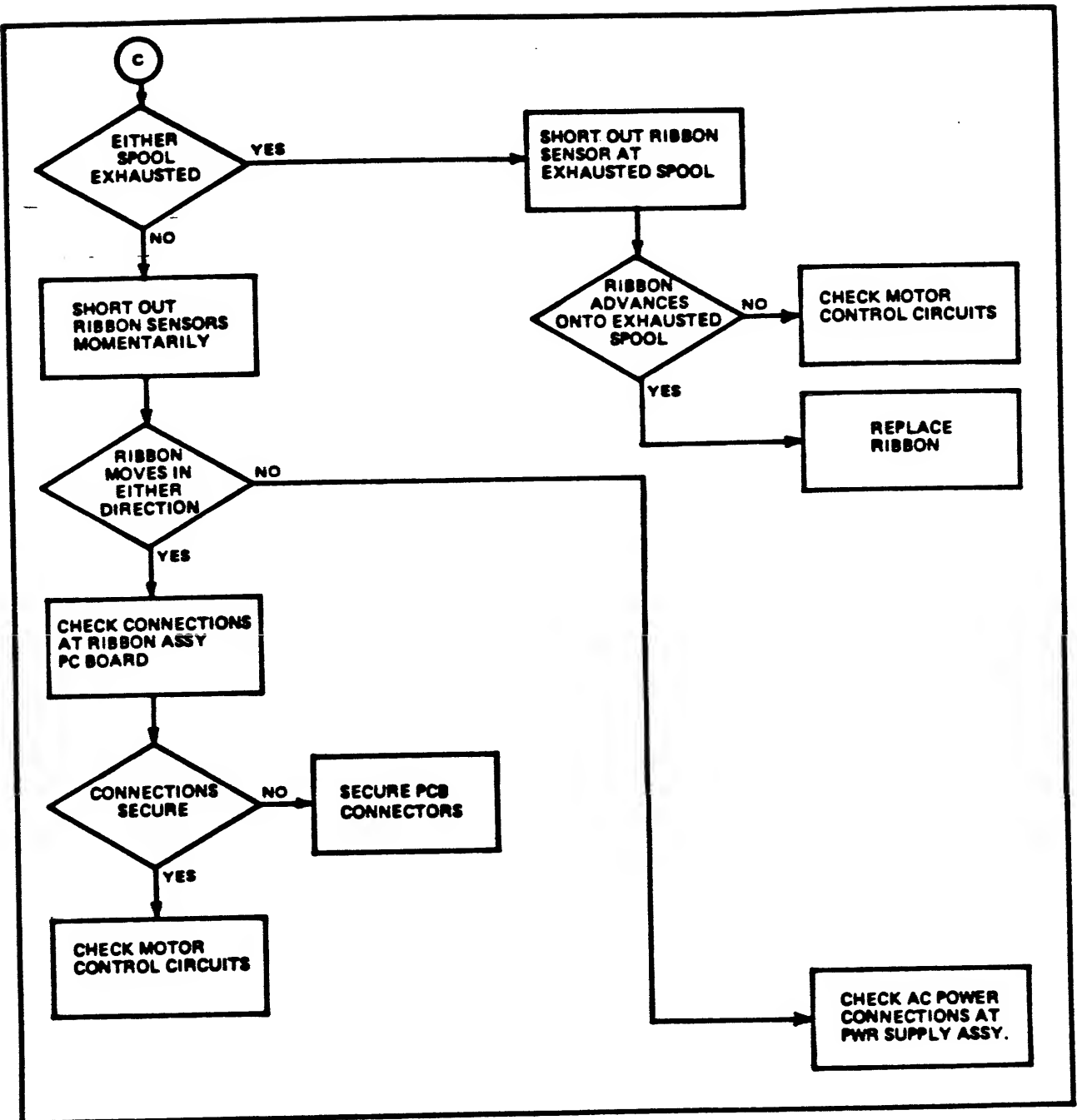


Figure 58 Ribbon Drive Assembly Circuits Flow Chart

4.9 TROUBLESHOOTING SHUTTLE ACTION

After power is applied and the ONLINE switch is pressed, shuttle action should time out in about six seconds. If it does not time out, there is a problem with the MPU or the PCBA circuitry it stimulates. The problem can be analyzed starting at the circuit breaker:

- a. If the circuit breaker trips (the motor may also overheat), the MPU is incorrectly adjusted or should be replaced, or the motor Trigger Relay circuitry is not functioning.

CAUTION

Do not force the circuit breaker back on; let the motor cool off.

- b. If the circuit breaker does not trip, the fault is in the PCBAs. To isolate the PCBA causing the problem, the LOGIC A PCBA, the LOGIC B PCBA and the Power Supply PCBA may be swapped for known good boards until shuttle action times out within the required six seconds. Alternately, scope the PCBAs per the following table, in the order given.

Normal signal quality for the Magnetic Pickup Assembly, MPU, RESYNC and NRESYNC should be as shown in **Figure 100**. NSPT should be a TTL level pulse train. Refer to the **P600 Drawing Manual** (Part No. 105485) for details of circuit logic.

LOCATION	SIGNAL QUALITY	NEXT ACTION
TP4 (MPU)	Normal	Check connector J4-2, P.S. PCBA
P.S. PCBA	Not Normal	Check T.P. RESYNC, Logic B
J4-2 (PICKUP)	Normal	Replace the Power Supply PCBA
P.S. PCBA	Not Normal	Replace the MPU Assy.
T.P. RESYNC	Normal	Check connector J3-5, Logic A
Logic B. PCBA	Not Normal	Replace Logic B PCBA
J3-5 (NRESYNC)	Normal	Check connector J3-37 (NSPT)
Logic A PCBA	Not Normal	Check interconnect cable
J3-37 (NSPT)	Normal	Check related circuitry on Logic B per Figure 54
Logic A PCBA	Not Normal	Replace Logic A PCBA

4.10 GENERAL PRINT PROBLEMS

The following group of figures present flow charts for diagnosing a number of specific symptoms. These are:

- Printer Will Not Go On Line (**Figure 59**)
- Power Lamp Does Not Light (**Figure 60**)
- Check Lamp On (**Figure 61**)

4.11 DROPOUT

Missing dot columns and/or missing dot rows are generally called dropout. **Figure 62** is an example of dropout. Dot dropout can be a result of:

- a. Hammer(s) tweaked too light or dark
- b. Improperly set platen gap.
- c. Hammer bank cover holes clogged with lint and ink.
- d. Malfunction Hammer Driver PCBA.
- e. Incorrect MPU Signal Amplitude.
- f. Poor ribbon condition.
- g. High heat due to poor ventilation of the Hammer Bank Assembly.
- h. Incorrect shuttle spring tension; shims migrate or break.
- i. Poor cable connector contact.

4.12 PRINT DENSITY

Print density problems may be caused by:

- a. Hammers improperly tweaked
- b. Malfunctioning coils.
- c. Malfunctioning Hammer Driver PCBA.
- d. Incorrectly adjusted platen gap.

Figure 63 shows samples from both an incorrectly adjusted hammer bank and a properly adjusted hammer bank.

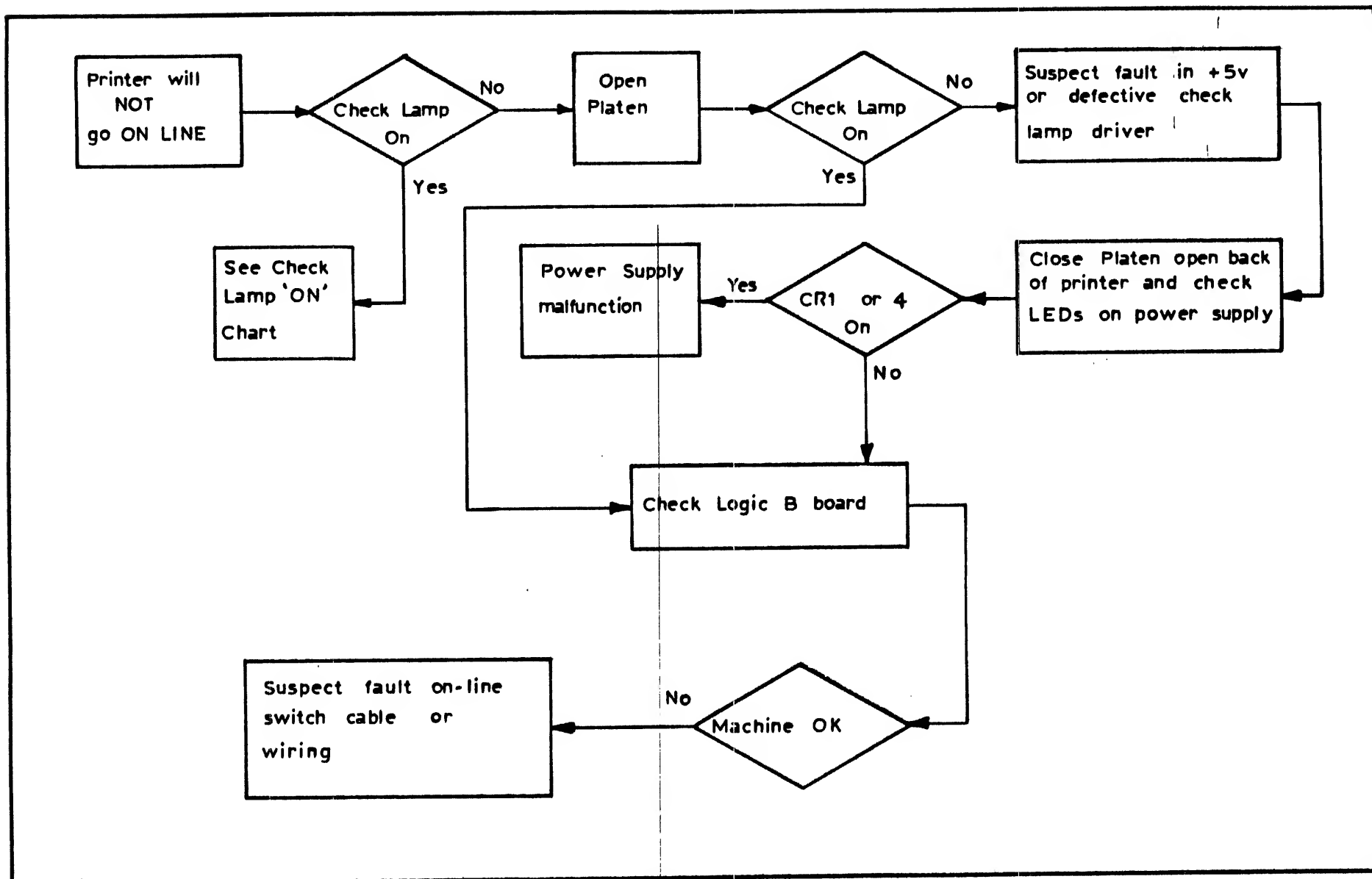


Figure 59 Printer Will Not Go On Line Flow Chart

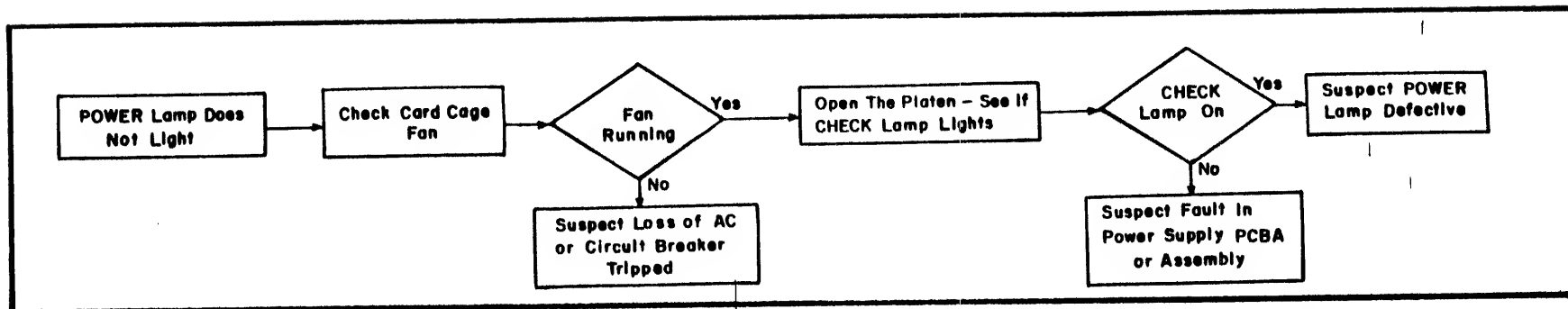


Figure 60 Power On Lamp On Not Lit

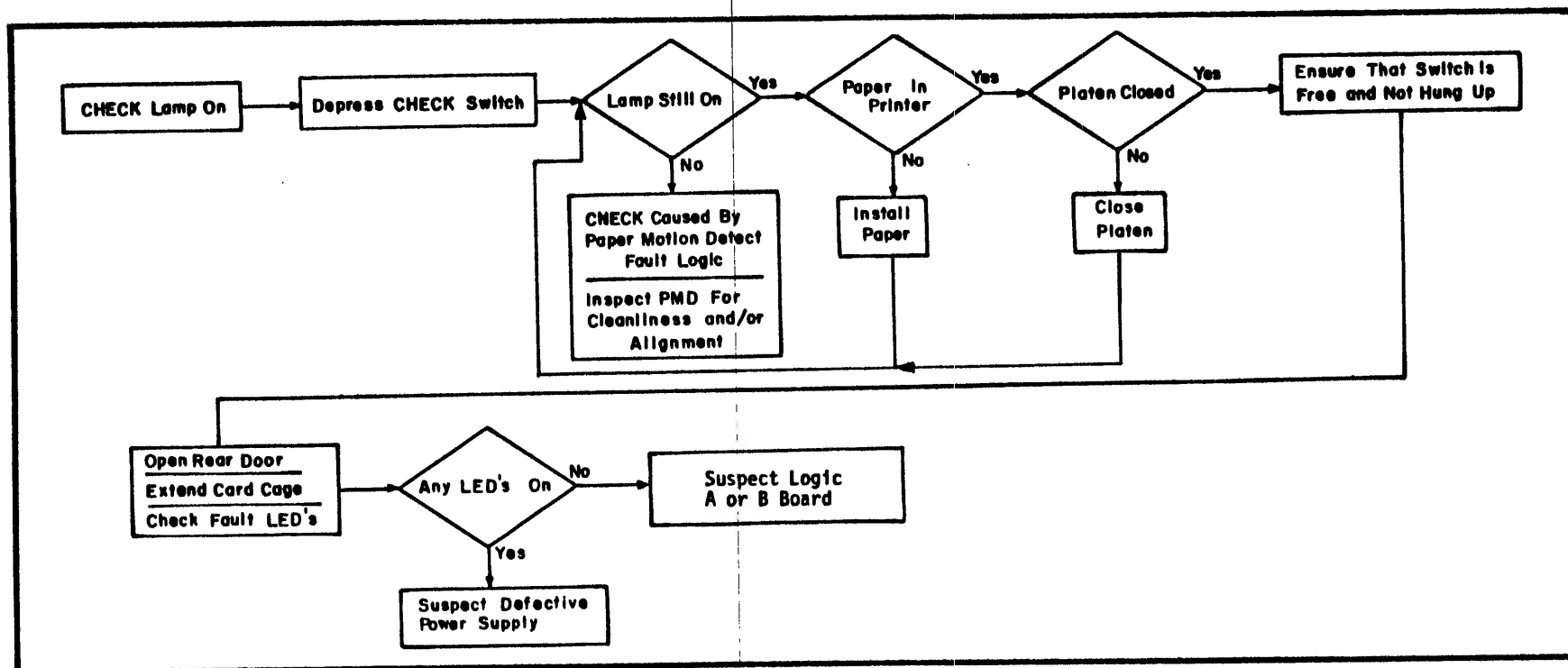


Figure 61 Check Lamp On

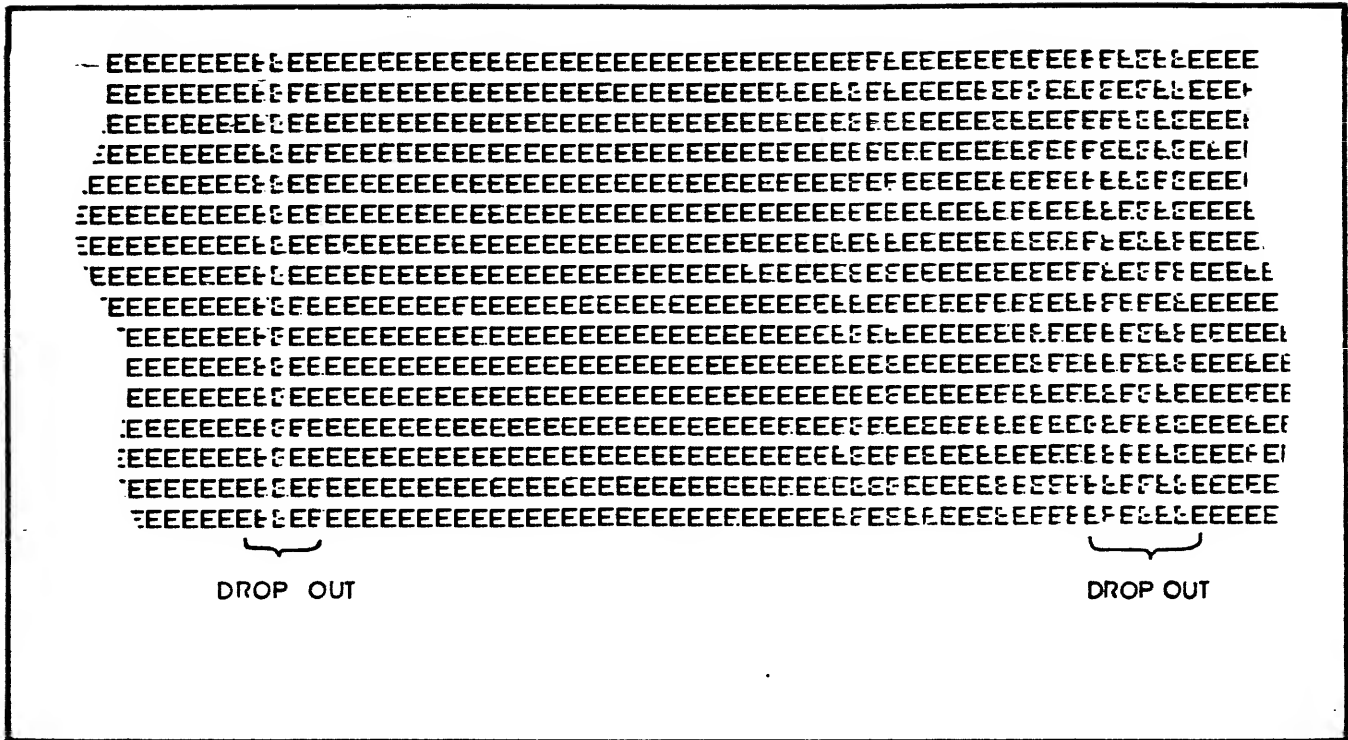
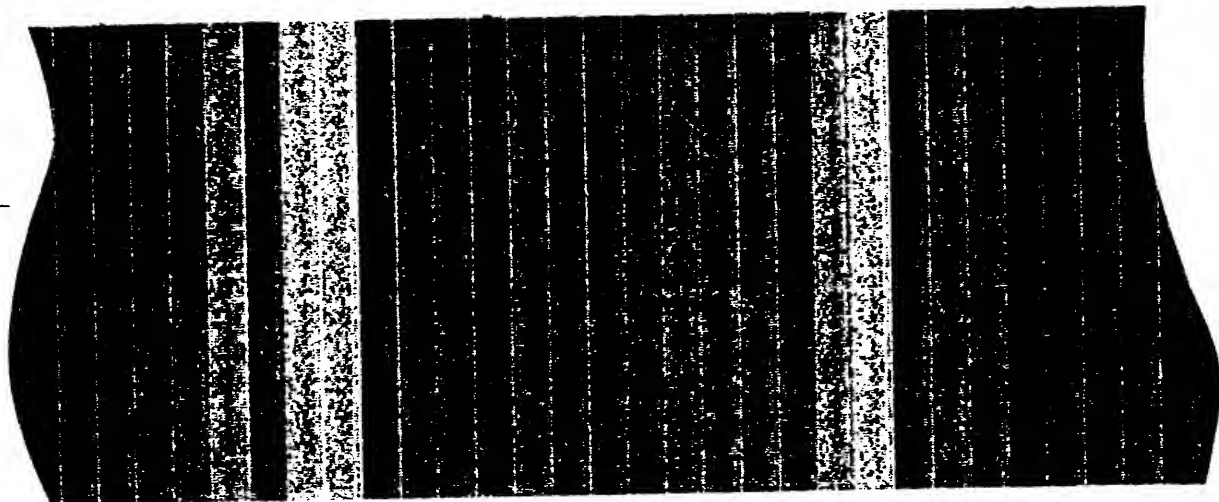


Figure 62 Examples of Dropout



.MNOPQRSTUVWXYZ[\]^_!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJK
 INOPQRSTUVWXYZ[\]^_!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKL
 JOPQRSTUVWXYZ[\]^_!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLM
 JQRSTUVWXYZ[\]^_!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN



?;<=>?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 ?;<=>?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 ;<=>?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 <=>?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 (=)?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 =>?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
 >?@ABCDEFGHIJKLMNPNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz

Figure 63 Print Density Requires hammer adjustment Requires no hammer adjustment

4.13 COMPRESSED PRINT

Vertical compression of print (**Figure 64**) may be a result of:

- a. Defective Logic B PCBA.
- b. Defective Power Supply PCBA.
- c. Defective paper feed motor.
- d. Friction in the paper train.
 1. Tractors too tight; replace per **Section 5**, subsection 5.32.
 2. Paper extruder; remove, not necessary to replace.
 3. Paper feed belt tension too tight; adjust per **Section 5**, subsection 5.28.
 4. Foreign object in paper path: clean per Preventive Maintenance **Section 3**.

4.14 HORIZONTAL HAMMER ALIGNMENT

White stripes during a solid plot are an indication of horizontal hammer misalignment (**Figure 65**). The dots will fall into individual groups for each hammer. The groups should neither overlap nor show spacing greater than 0.005 inch. Misalignment is not obvious from printing character lines since the intercharacter space masks the effect. Instead, a solid black plot must be run to disclose hammer misalignment. Set the exerciser controls as follows and run three or four inches of plot.

CAUTION

To avoid overheating the shuttle, do not run more than 3-4 inches of this plot in an overall time period of 30 seconds.

Exerciser Control Settings:

- Line length = 132
- Character = Delete
- Special = Plot
- Function = Line Feed

Necessary hammer alignment may be done according to the procedure given in **Section 5** by:

- a. Rotating the Hammer Bank into the service position per subsection 5.15.
- b. Performing a hammer adjustment per subsection 5.16.
- c. Restoring the hammer bank to its operating condition per subsection 5.15.

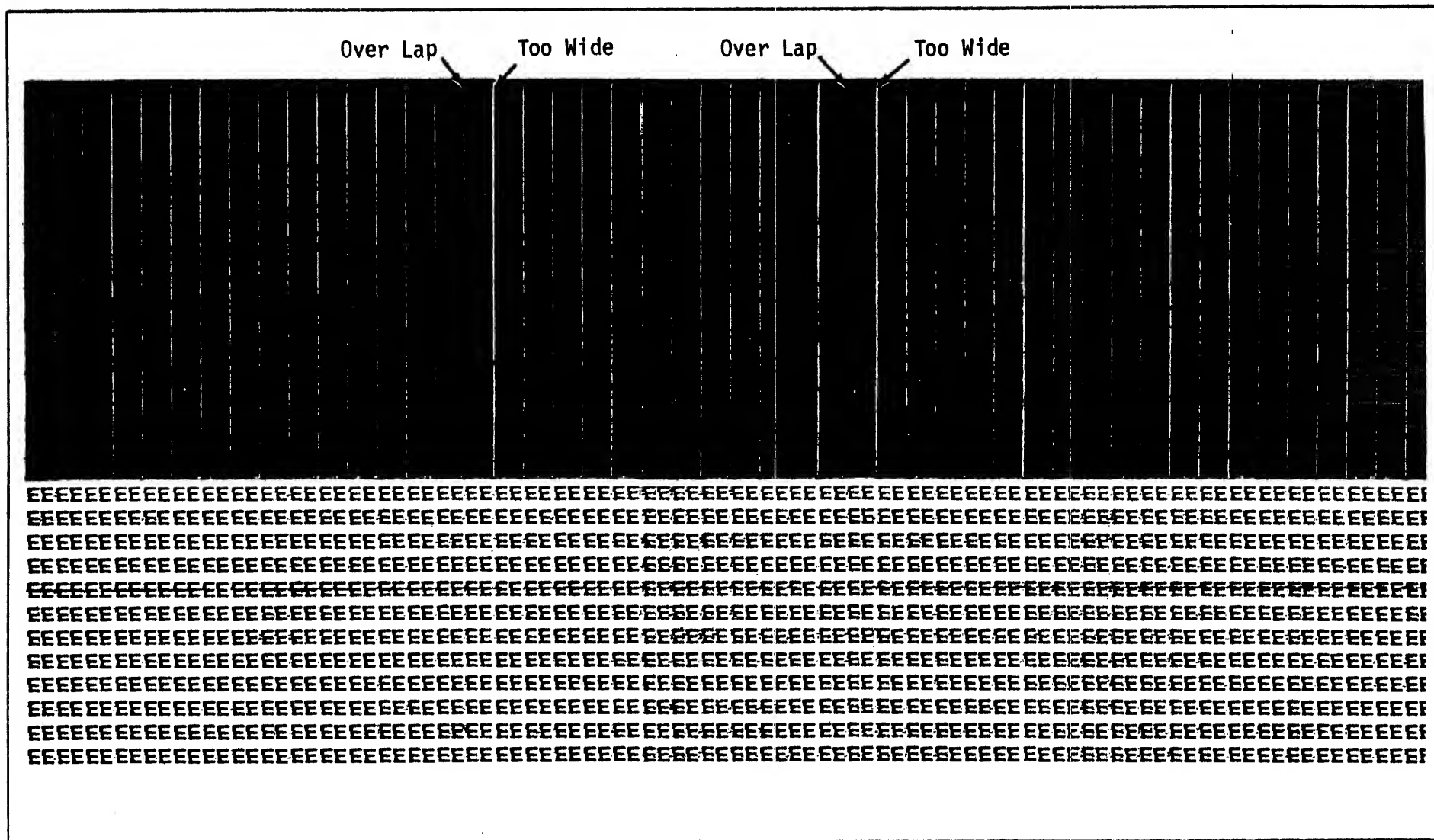


Figure 65 Horizontal Hammer Alignment

4.15 DRAGGING HAMMERS

Dragging hammers are called nonretractors. The most obvious symptom of a dragging hammer is a ribbon having any of the following problems:

- a. Will not run smoothly through the guides.
- b. Tends to pull out of the ribbon mask.
- c. Wraps poorly on the take up reel.
- d. Is perforated or torn.
- e. Occasionally separates from the spool when the Ribbon Drive Assembly fails to reverse ribbon travel.

These other symptoms are print problems:

- a. Light and smeared characters for a particular hammer.
- b. Retrace patterns during line spacing.
- c. Dot row 1 is overprinted across the entire character space.

Figure 66 illustrates these conditions of print.

4.16 RIBBON PROBLEMS

Besides the dragging hammer symptom, ribbon feed problems can be caused by:

- a. Lint, chaff, or ink accumulations in the ribbon path.
- b. A fractured ribbon guide which misaligns the ribbon path.
- c. A bent or torn ribbon mask.
- d. A bad ribbon drive motor.
- e. The ribbon motor connectors on the Ribbon Control PCBA may be interchanged
- f. An electronic failure in the PCBAs.

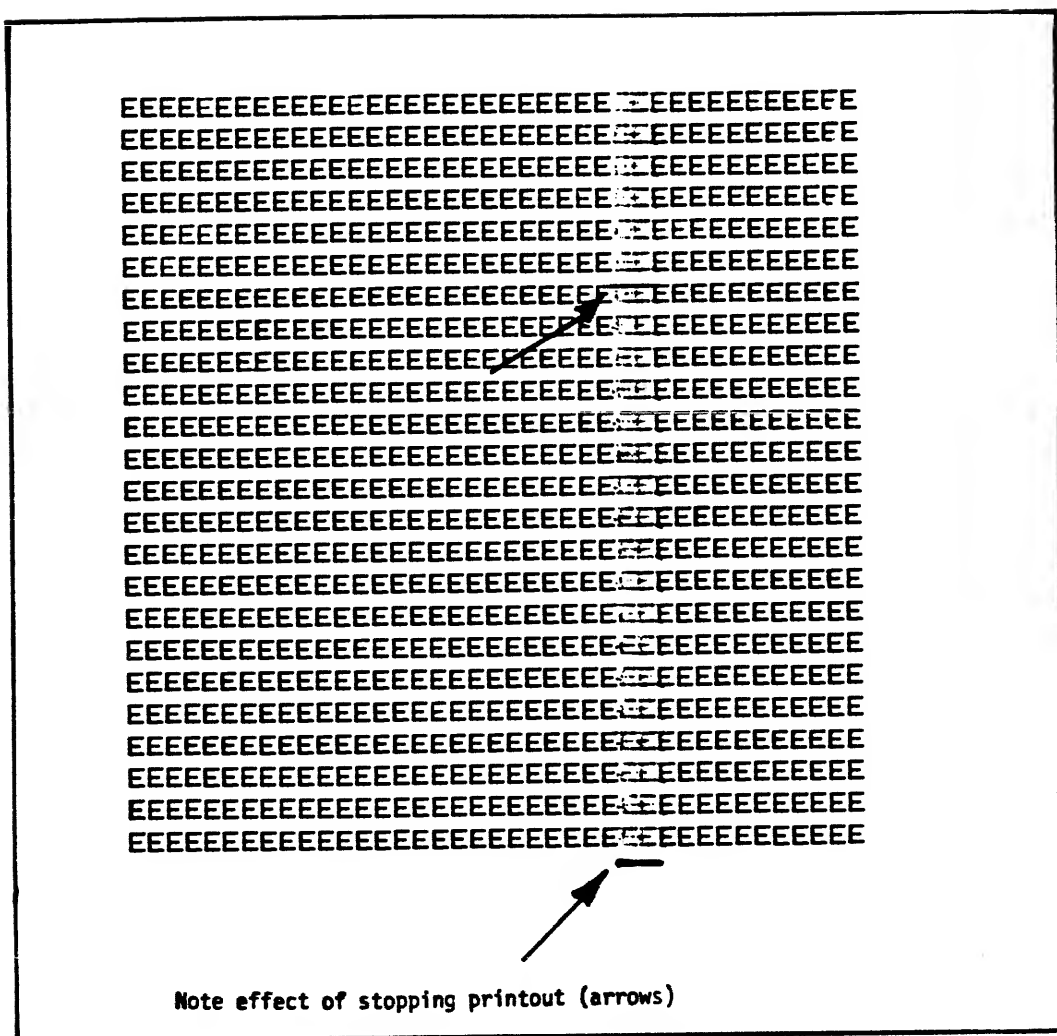


Figure 66 Example of Dragging Hammer

4.17 IMPROPER ADJUSTMENT SYMPTOMS

Improper printer adjustments can cause symptoms previously listed. The following is offered as a quick summary of the symptoms associated with the incorrect adjustments:

- a. Hammer Tip to Platen Gap.
 - Paper jams.
 - Compressed print.
 - Extra dots.
 - Faint print or no print, especially at one side or the other.
- b. MPU PHASING.
 - Print break up.
 - Vertically misaligned dots.
- c. MPU Gap.
 - Garbled print.
 - No print accompanied by a tripped circuit breaker, an overheated shuttle motor, or both.

4.18 PERFORMANCE TESTS

This section describes tests to be performed routinely or following the completion of maintenance procedures. These tests are performed using the Printronix Exerciser (P/N 101635) or the appropriate diagnostic program.

Figures 67 through 75 show typical test printouts obtained with the Exerciser controls set as indicated. Note that the Exerciser LINE LENGTH switch is always set to 132, and the FUNCTION switch is set to LINE FEED position.

Illustrated printouts are as follows:

FIGURE	DESCRIPTION
---------------	--------------------

67	Sliding pattern, all Upper and Lower Case Characters (test for normal printing)
68	Test for MPU phasing (Letter H)
69	Letter "E", Elongated (test for printing uniformity)
70	Underlines (test for hammer alignment, vertical)
73	Recycle Pattern, Upper and Lower Case Characters (general test)
74	Upper Case Characters, Row Increment (general test)
75	Self-test (Letter E)

```

HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNR
IJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNR
JKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNR
LMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRST
LMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTU
NOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUV
NOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVW
OPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXY
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
QRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
QRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
STUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
TUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
UVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
WXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ
XYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ @ABCDEFGHIJKLMNPNRSTUVWXYZ

```

```

LINE LENGTH   = 132
CHARACTER     = SRO-96
SPECIAL       = NONE
FUNCTION      = LINE FEED

```

Figure 67 Sliding Pattern, All Upper and Lower Case Characters, Sample Printout

4.19 TEST FOR NORMAL PRINTING

To check that all characters are being printed, perform the following procedures:

- Prepare the printer for normal operation, using 14 7/8-inch, single part paper.
- Set Exerciser controls as follows:
 - Line Length = 132 (or corresponding to paper width).
 - Character = SRO-96 if lower case character set installed; otherwise, SRO-64.
 - Special = None.
 - Function = Line Feed (LF).
- Place the printer ON LINE by pressing the ON LINE pushbutton. Print one half page of the sliding pattern, then press the ON LINE pushbutton again to take the printer Off Line.
- Examine the printout. All characters should appear in each line of print. **Figure 67** illustrates the correct print.

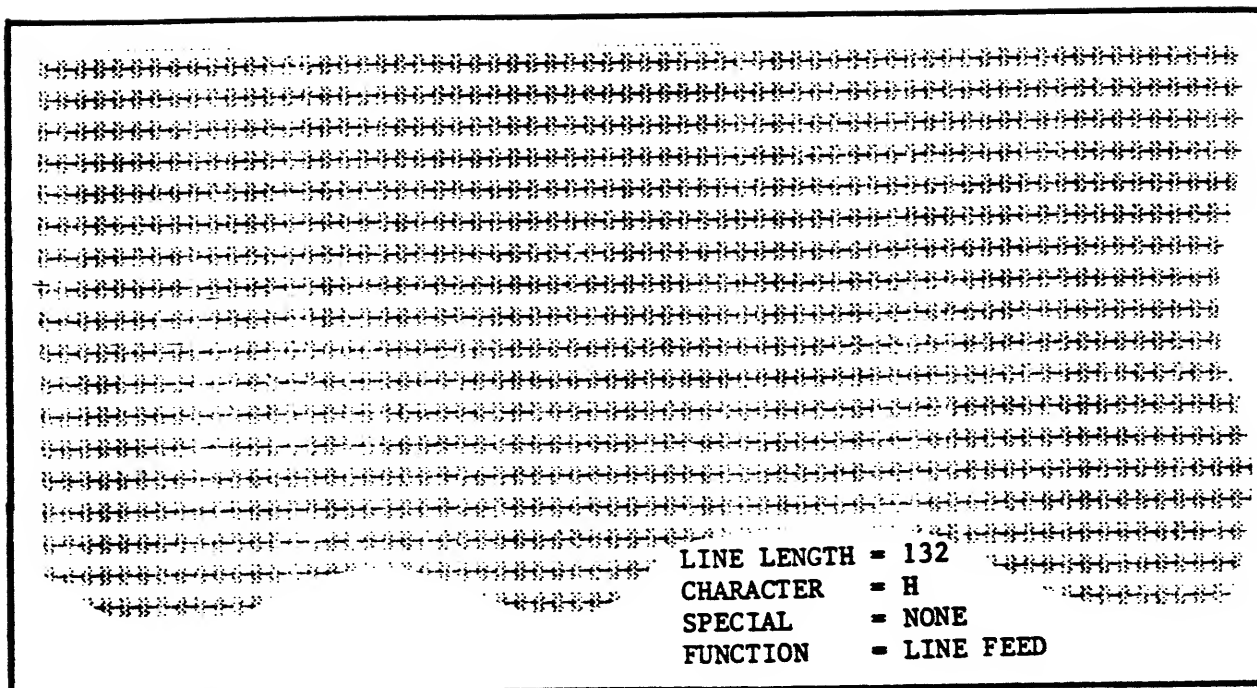


Figure 68 Test for SYNC Phasing, Sample Printout

4.20 TEST FOR MPU PHASING

Print quality may be poor if MPU phasing to RESYNC is not correct. Incorrect MPU phasing causes dots in any dot column to be staggered in alternate rows (Figure 68).

To check MPU phasing, proceed as follows:

- a. Prepare the printer for normal operation, using 14 78-inch single part paper.
- b. Set Exerciser controls as follows:
 - Line Length = 132 (or corresponding to paper width).
 - Character = H.
 - Special = none.
 - Function = Line Feed (LF).
- c. Press the ON LINE pushbutton to put the printer on line. Permit the printer to print one half page of the letter H. Again press ON LINE to take the printer off line.
- d. Examine the printout for vertical alignment of dots in alternate dot rows. If dots are staggered more than 0.005 inch, perform MPU phasing adjustments described in Section 5, subsection 5.25.

4.21 TEST FOR PRINT UNIFORMITY

To test print uniformity, proceed as follows:

- a. Load 14 7/8-inch, six-part paper into the printer.
- b. Set Exerciser controls as follows:
 - Line Length = 132.
 - Character = E.
 - Special = Elong, character.
 - Function = Line Feed (LF).
- c. Press the ON LINE pushbutton and print two full pages of the elongated letter E. Then press ON LINE to take the printer off line.
- d. Examine the first and last sheet of both pages of print. Printing should be distinct and uniform with no faded characters. If the printout is not satisfactory, check the hammer tip to platen gap (refer to Section 5, subsection 5.13). See Figure 69 for sample printout.

4.22 TEST OF HAMMER ALIGNMENT, VERTICAL

To verify that hammers have been properly aligned vertically, proceed as follows:

- a. Load 14 7/8-inch single part paper into the machine.
- b. Set the Exerciser controls as follows:
 - Line Length = 132 (or corresponding to paper width).
 - Character = Space or delete.
 - Special = Underline.
 - Function = Line Feed (LF).
- c. Place the printer ON LINE by pressing the ON LINE pushbutton. Print one half page of underlines. Press the ON LINE pushbutton to take the printer off line (Figure 70).
- d. Examine the printout for straight underlines. Check at hammer boundaries for distortion. Any deviation from a straight line may indicate hammer(s) are out of adjustment or there is a lack of proper tension on the paper train.

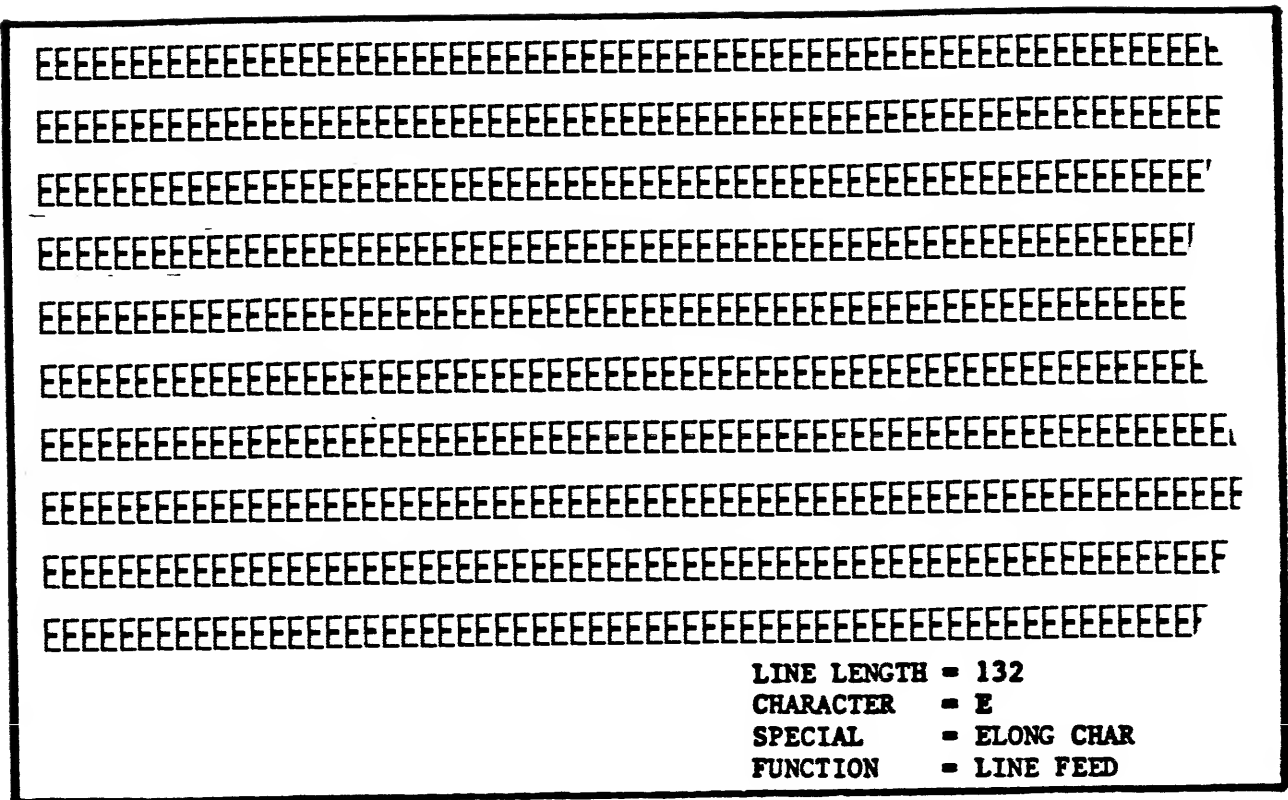


Figure 69 Letter 'E' Elongated, Sample Printout

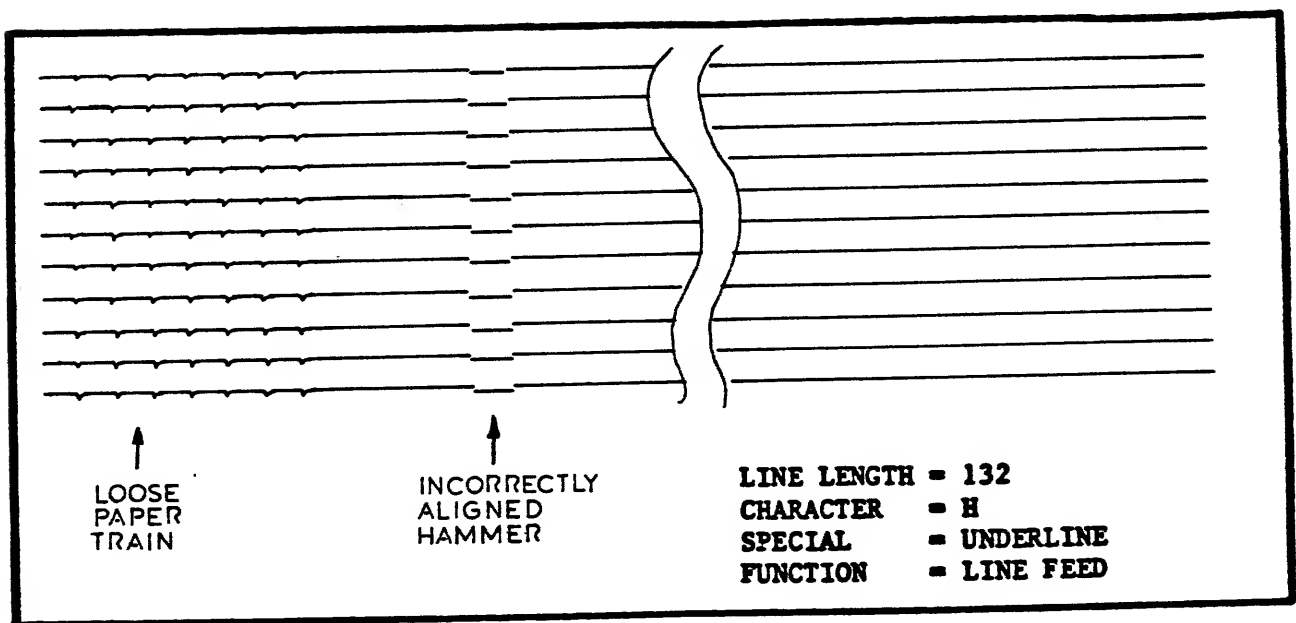


Figure 70 Underlines, Sample Printout

4.23 OTHER TESTS

Figures 73, 74, and 75 illustrate other optional test patterns for general verification of printer performance.

NOTE

The self test pattern is an internally contained test which may be performed while the printer in ON LINE to a data source. Self test printing will interrupt the data path between the data source and the on line printer without any change in status to the interface. Therefore, self test should be used with discretion.

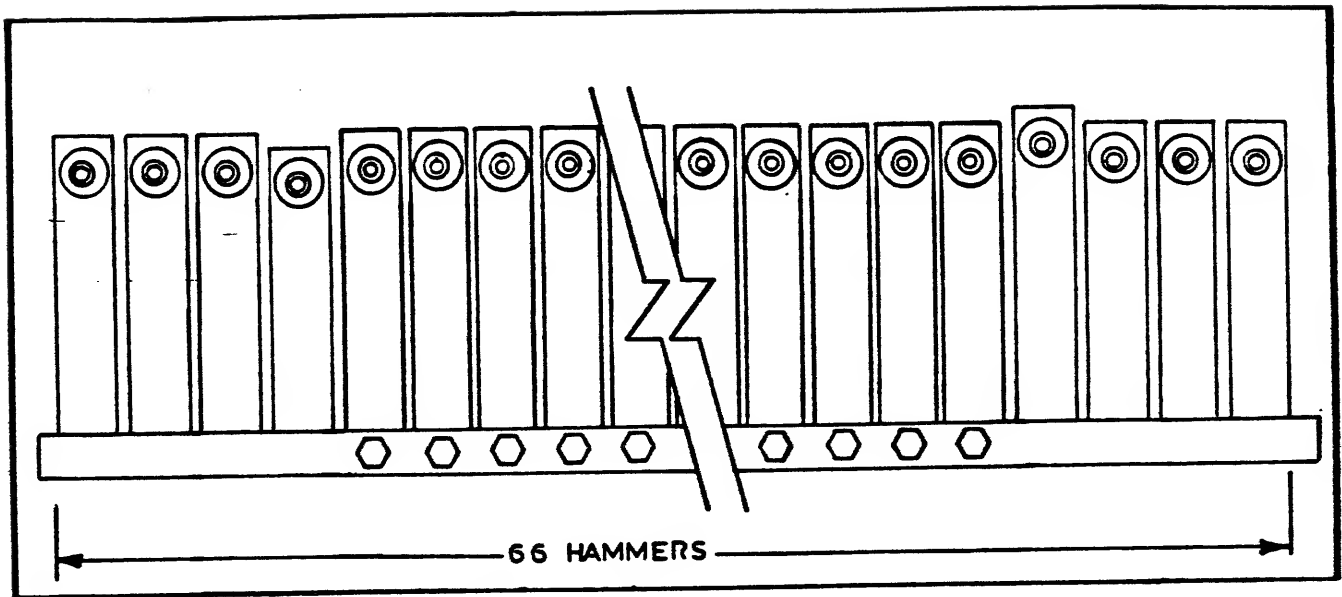


Figure 71 Example of Vertically Misaligned Print Hammer Arrangement (Vertical Displacement Exaggerated)

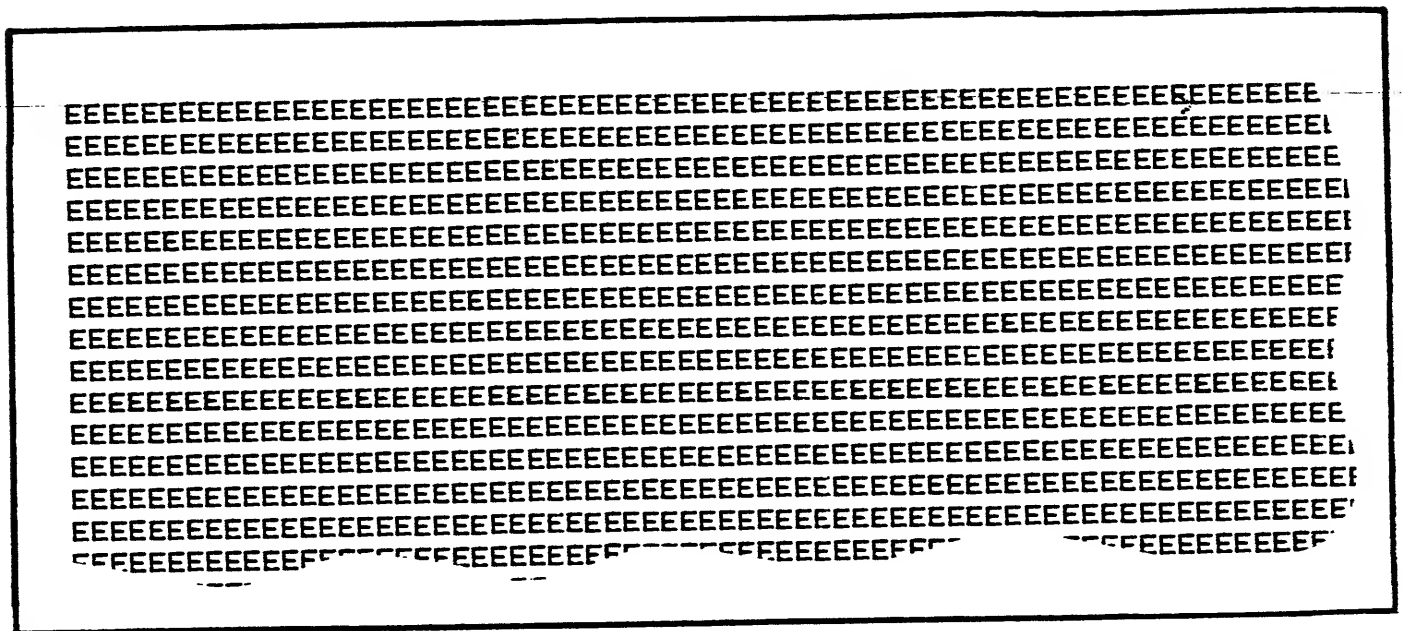


Figure 72 Self-Test, Sample Printout

(Place printer ON-LINE, then simultaneously depress both check switch and paper advance switch).

LINE LENGTH = 132
CHARACTER = SR0-96
SPECIAL = RECYCLE
FUNCTION = LINE FEED

LINE LENGTH = 132
CHARACTER = SRO-64
SPECIAL = ROW INC
FUNCTION = LINE FEED

ADJUSTMENT, REMOVAL, AND REPLACEMENT PROCEDURES

The following subsections outline procedures for performing mechanical adjustments and modular removal and replacement of the principal assemblies of the printer (**Figure 76**). Refer to the Printronix Illustrated Parts Breakdown (IPB), Part Number 105446 for additional information.

Unless stated otherwise, these procedures are performed with AC power disconnected from the printer.

5.1 REPLACING A CIRCUIT BOARD IN THE CARD CAGE

Before removing any PCBA from the card cage, turn off the AC power. Lower the back cover; then swing open the card cage which is held in place by a magnetic latch.

To remove either Logic PCBA, lift its ejector levers and release the PCBA from its connectors; then withdraw the PCBA from the card cage. (**Figure 77** illustrates this procedure.)

NOTE

If the Logic A PCBA is to be replaced, remove the jumper platform (location 8K and 9K), the terminations (location 2A and 3A) and the logic control PROMs (location 10D, 11D, and 12D) from the PCBA to be replaced. Install the removed parts in the same locations in the replacement PCBA.

If the Logic B PCBA is to be replaced, remove the Velocity PROM (location 11L) and the Hammer Reset Timer board (location 2L) and install the removed parts in the replacement PCBA.

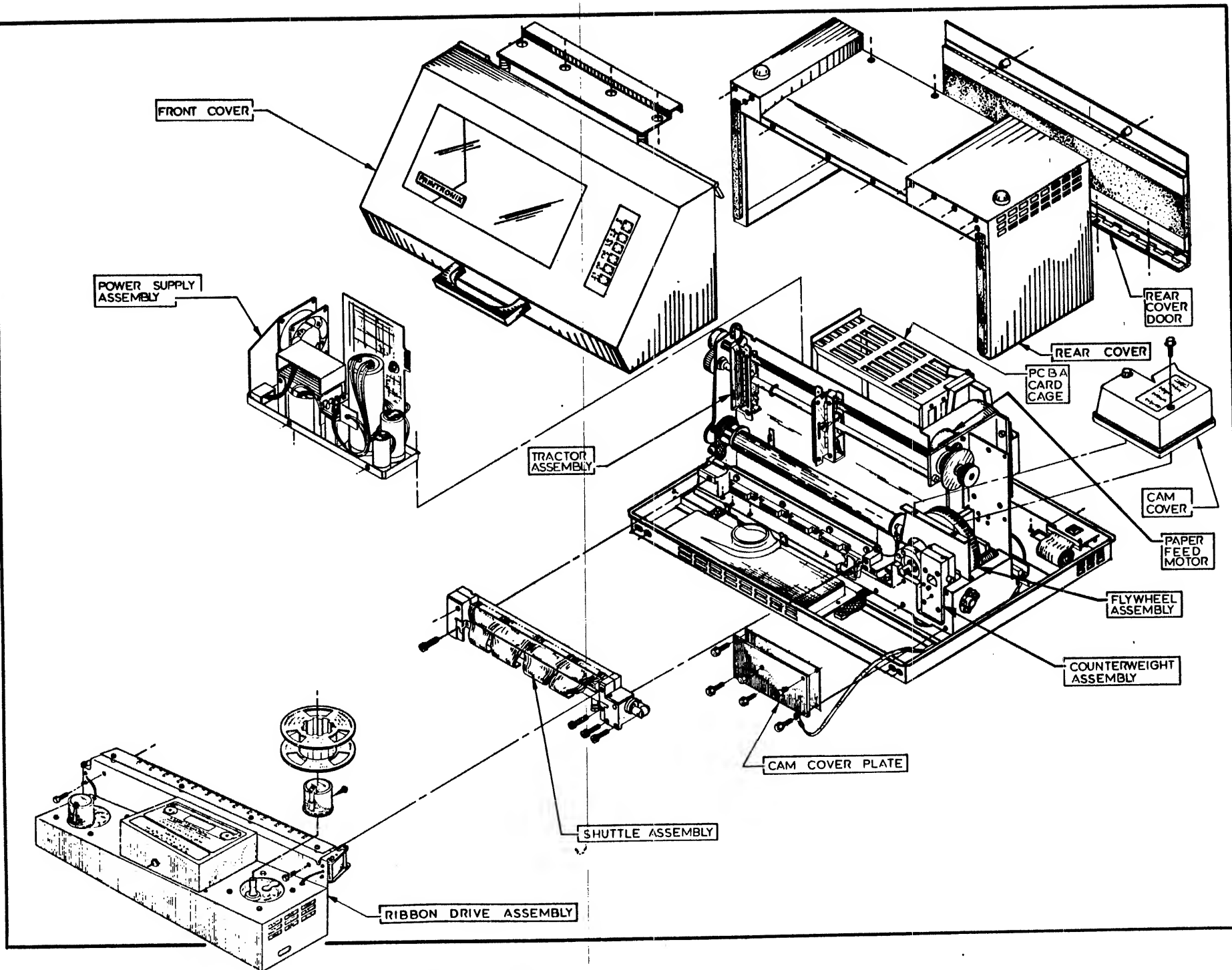


Figure 76 Principal Printer Assemblies

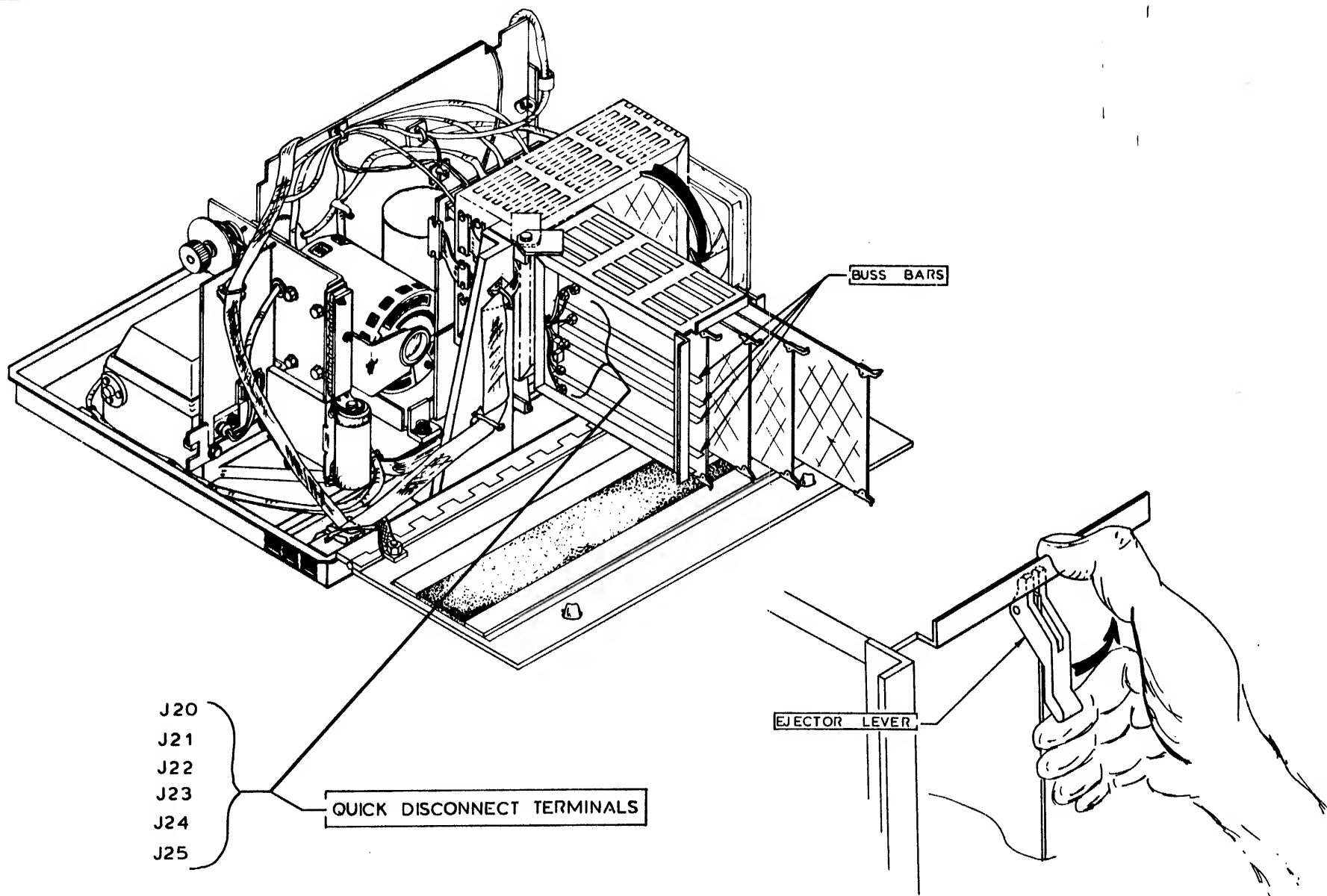


Figure 77 Replacing Circuit Boards in the Card Cage

To remove the Hammer Driver PCBA from the card cage, proceed as follows:

- a. The + 70 volt supply must be discharged before Hammer Driver PCBA removal. To do this, place a 1K ohm resistor between any adjacent pair of buss bars on the Hammer Driver PCBA for one minute.
- b. Disconnect the six wires terminated with quick disconnect terminals (J20 through J25) from the terminals on the PCBA (Figure 77).
- c. Lift the ejector levers on the Hammer Driver PCBA to release the PCBA from its connectors; then withdraw the PCBA from the card cage.

To reinstall any PCBA in the card cage, insert the PCBA into its slot until its connector fingers engage the connectors; then press the board into the connectors by returning the ejector levers to their normal positions. Be sure to correctly connect the six wires (marked J20 through J25) to their respective terminals on the Hammer Driver PCBA.

Observe PCBA identification on the outboard edge of the card cage. PCBAs are designed so that no damage will occur if a PCBA is inserted in the wrong slot. The PCBA cannot be installed upside down in the card cage. Never attempt to force a PCBA into the connector.

CAUTION

To prevent damage to a PCBA mounted on an extender board during maintenance, be sure the PCBA is oriented on the extender board in the same way it would be in the card cage. It is possible to mount the PCBA upside down on an extender board.

5.2 REMOVING AND REPLACING THE PRINTER COVER

It may be necessary to remove the printer cover in order to perform some maintenance procedures.

WARNING

When the cover is removed from the printer with power on, it is possible to encounter moving machinery and hazardous voltages while working within the printer. Take care not to touch points carrying AC line voltage. Keep metal tools and jewelry away from power supply voltages. When the shuttle is operating; keep hands, arms, and clothing away from the shuttle assembly, its drive belt, and the flywheel assembly.

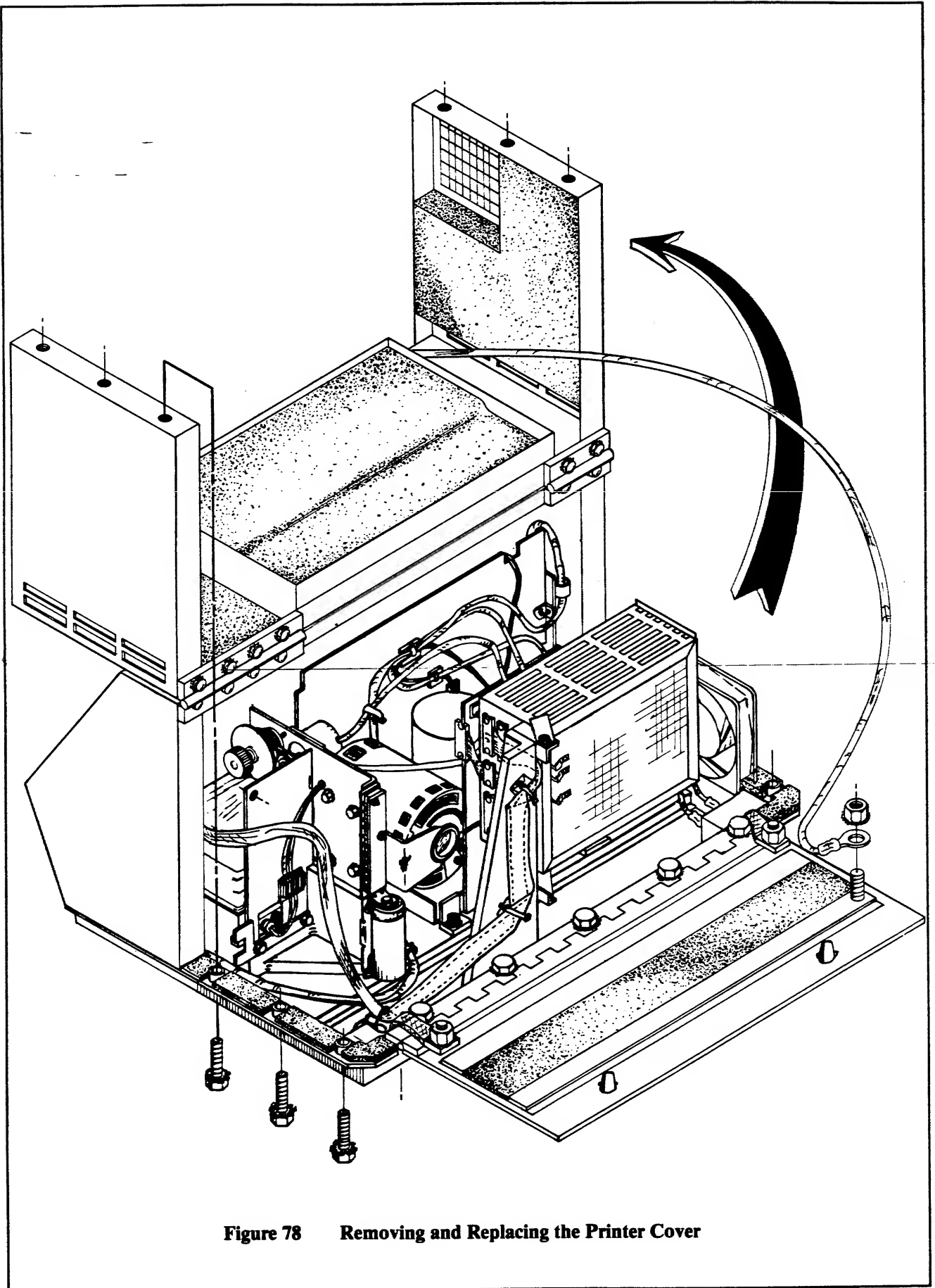


Figure 78 **Removing and Replacing the Printer Cover**

To remove the printer cover, refer to **Figure 78** and proceed as follows:

- a. Turn off AC power.
- b. Remove the external I/O cable from the rear of the printer.
- c. Remove all cover screws from under the edges of the base support assembly (pan).

CAUTION

Support the rear cover door in some way prior to removing the wire rope from the rear cover during the next step. This will prevent the door from dropping down onto (and stressing) any cables connected to the back of the printer.

- d. Disconnect the rear cover door stop (wire rope) from the rear of the printer cover. It is not necessary to remove the ground straps or the piano hinge.
- e. Hinge the rear cover onto the front cover.

Reinstall the cover by reversing removal procedures.

5.3 REPLACING THE CONTROL PANEL

To remove and replace the control panel, proceed as follows:

- a. Open the printer front cover.
- b. Remove the four nuts and washers that hold the control panel and the control panel rear cover. Remove the wire clip that guides the cable to the front cover (the clip just slips under the soundproofing pad). Then remove both the cover and the control panel with its cable.
- c. To completely remove the control panel along with its cable, remove the screws holding connector J1 (of Logic B PCBA) at the card cage; then cut cable ties as necessary to remove the cable and the control panel (**Figure 79**).
- d. To replace the control panel, reverse removal procedures, installing the cable ties after the cable connector and the control panel have been secured.

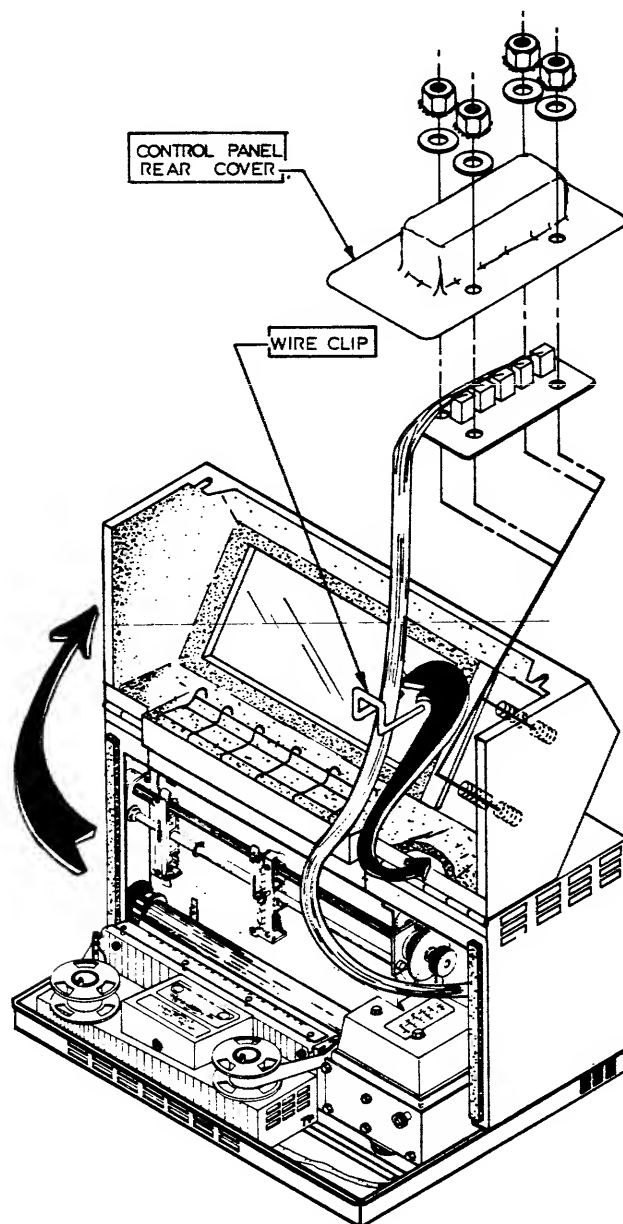


Figure 79 Replacing the Control Panel

5.4 REPLACING AN INDICATOR LAMP

To replace a lamp in a control panel switch/indicator, proceed as follows:

- a. Grasp the upper and lower slots in the lens, and pull the lens away from the panel.
- b. Use the relamping tool to grasp and remove the lamp.
- c. With the relamping tool, install the new lamp.

NOTE

Relamping tools should be used only as a holder for aligning the lamp base into its socket.

- d. Press the lens back into place until it snaps into normal position.

5.5 REPLACING A CONTROL PANEL SWITCH OR INDICATOR

To replace a failed switch or indicator on the Control Panel, proceed as follows:

- a. Remove the four nuts and washers that hold the Control Panel and its rear cover. Remove the rear panel cover.
- b. Label all wire connections to the switch/indicator to aid in correct reconnection. Then unsolder all wires from the switch.
- c. To remove a switch/indicator press the spring clips (on the rear of the Control Panel) against the body of the switch/indicator, and push the switch/indicator out through the front of the panel.
- d. To install the replacement switch/indicator correctly orient the solder terminals of the unit, then push the replacement switch/indicator through the front of the panel until it seats and its retaining clips open at the rear of the panel.
- e. Solder all the wires to related solder terminals.
- f. Reinstall the rear cover and its four nuts and washers on the rear of the Control Panel.

5.6 THE RIBBON DRIVE ASSEMBLY

The Ribbon Drive Assembly is secured to the hammer bank bearing blocks by two Allenhead bolts. The assembly contains drive motors, ribbon spool hubs, a blower to cool the hammer bank, and the Ribbon Control PCBA. Cables from other assemblies connect to the PCBA.

5.7 REMOVING AND REPLACING THE RIBBON DRIVE ASSEMBLY

To remove and replace the entire Ribbon Drive Assembly for repair or maintenance of adjacent modular assemblies proceed as follows:

NOTE

For most maintenance procedures, it is not necessary to disconnect the cables from the Ribbon Control PCBA. The Ribbon Drive Assembly can be held in the service position by mounting the assembly on the vertical cover support pin on the printer base. To do so, slip the keyhole shaped cutout at the right rear of the assembly over the shoulder screw on the cam plate cover (**Figure 80**).

- a. Turn off AC power to the printer.
- b. Set the Forms Thickness Adjustment lever to the Load position (fully raised).
- c. Remove the ribbon spools from the Ribbon Drive Assembly hubs.
- d. Remove the two screws that hold the upper rear of the Ribbon Drive Assembly to the hammer bank bearing blocks (**Figure 80**).
- e. Raise the Ribbon Drive Assembly approximately 3/8 inch, then lift the assembly off the retaining clips at the bottom rear of assembly.
- f. If the Ribbon Drive Assembly is to be removed from the printer, label connectors J1, J2, and J3 on the Ribbon Control PCBA. Disconnect the connectors from the PCBA and remove the Ribbon Drive Assembly from the printer.

To replace the Ribbon Drive Assembly, reverse removal procedures, being careful to connect the cables to the proper connectors on the PCBA.

NOTE

When installing the ribbon, be sure that the ribbon runs between the hammer bank cover and the ribbon mask. Placing the ribbon in front of the ribbon mask will result in ribbon smears, poor print quality and ribbon damage.

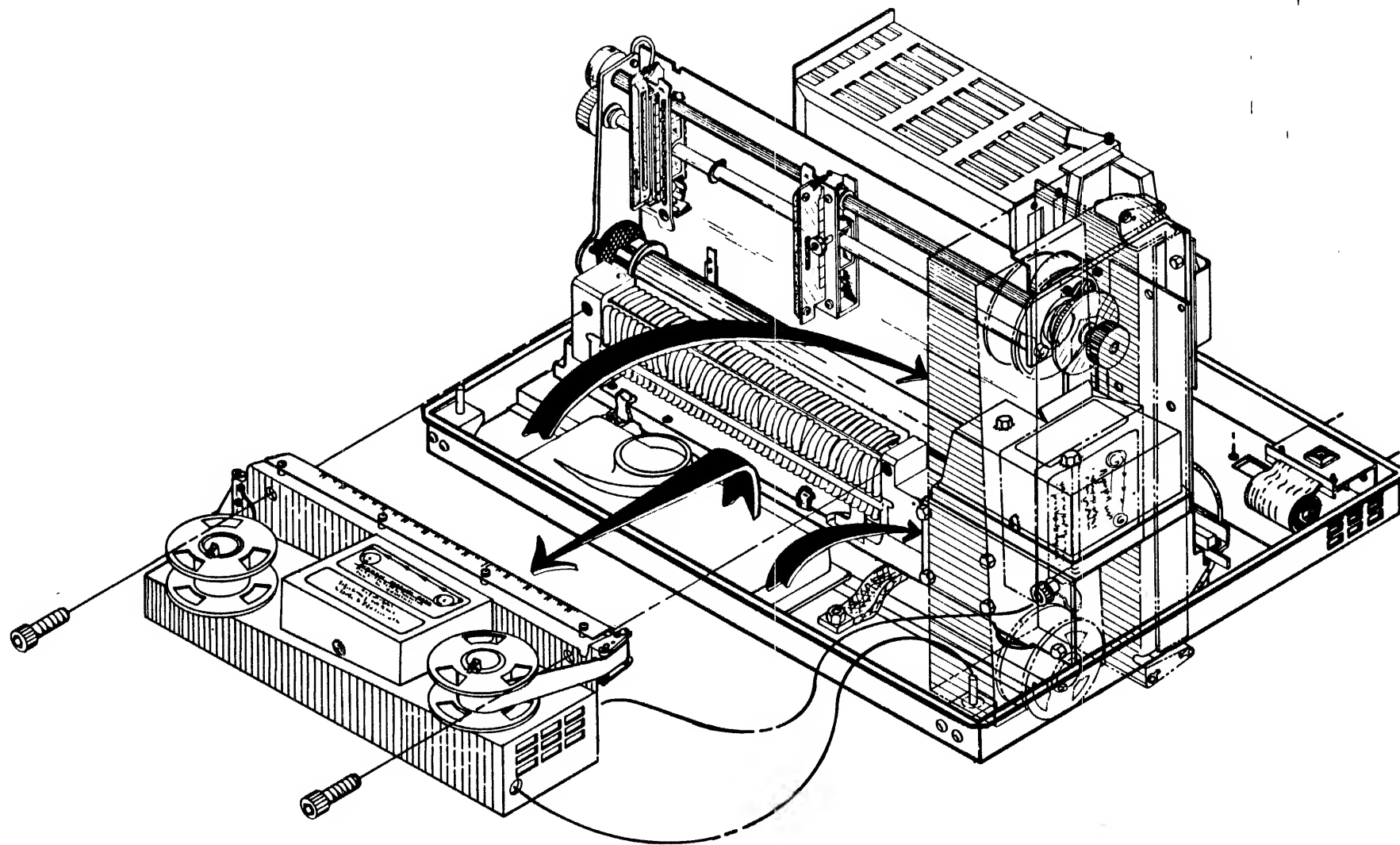


Figure 80 Ribbon Drive Assembly Removal

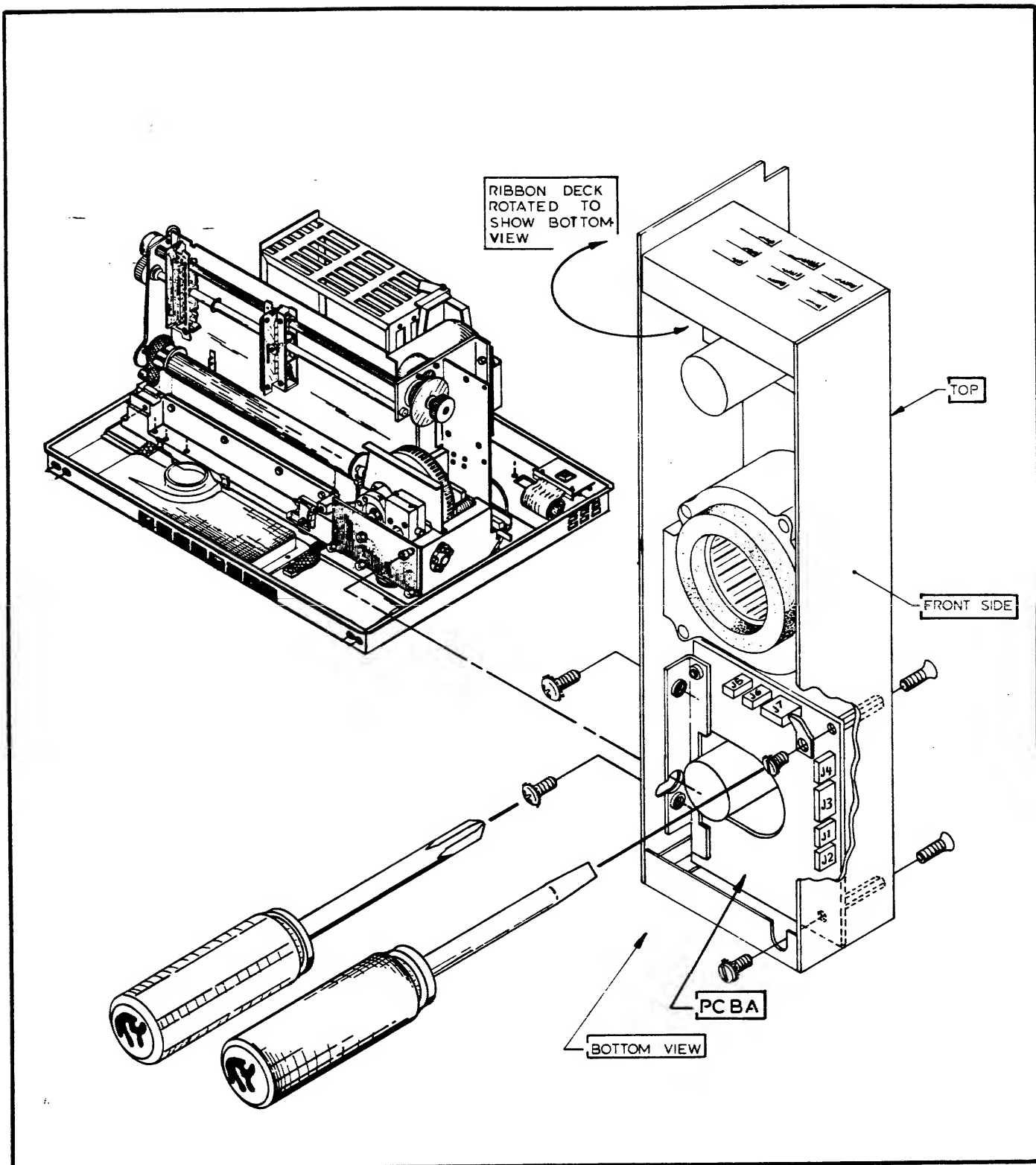


Figure 81 Ribbon Drive Assembly, Underside

5.8 REMOVING AND REPLACING THE RIBBON CONTROL PCBA

To remove and replace the Ribbon Control PCBA (**Figure 81**), perform the following procedures:

- a. Remove the Ribbon Drive Assembly per subsection 5.7.
- b. Set the Ribbon Drive Assembly upside down.
- c. Label and disconnect all cables remaining on the PCBA.
- d. Remove the two retaining screws from the PCBA, and the two PCBA retaining screws from the front of the Ribbon Drive Assembly chassis. Remove the PCBA from the chassis (**Figure 81**).

NOTE

For Printronix Printer Serial Number C31579 and later, remove the four nuts retaining the Ribbon Motor and rotate the motor 180 degrees to remove the PCBA.

CAUTION

Connectors are keyed so that they cannot be installed backwards. However, it is possible to reverse connections between J1 and J2, and between J5 and J6. **DO NOT FORCE CONNECTIONS.**

- f. Replace the Ribbon Drive Assembly per subsection 5.7.

5.9 ADJUSTING THE RIBBON HUBS AND GUIDES

Incorrectly adjusted ribbon spool hubs and ribbon guides will cause the ribbon to fold over and create missing print and ribbon damage. (Ribbon fold over may also be caused by a worn out ribbon.)

Adjust the height of the ribbon spool hubs, performing the following steps at each hub:

- a. Remove the ribbon spools from both hubs.
- b. Check the distance between the bottom flange surface of the hub and the surface of the gear box. The hub should just clear the gear box surface. If the hub is too high, loosen the hub set screw and lower the hub. Retighten the set screw.

To check and adjust ribbon tracking adjust the hubs and proceed as follows:

- a. Install paper in the printer and mount the ribbon spools on the hubs with the full spool on the right hand hub. Open the rear access door so the connectors on the Power Supply PCBA are accessible.
- b. Turn on the AC power to the printer.
- c. Set the Forms Thickness Adjustment lever to any position between Load and position 6 that permits the CHECK indicator to remain off.
- d. Put the printer ON LINE.
- e. Start printer printing with an Exerciser or Self-Test. Disconnect J4 on the Power Supply PCBA after printing has begun.

CAUTION

J4 must be reconnected after any power shut off is performed. Failure to reconnect J4 will result in tripping the circuit breaker and/or overheating the shuttle motor. If the shuttle motor overheats, reconnect J4 and allow the motor to cool. Reset the circuit breaker and attempt to restart the printing sequence. Be sure printing starts before disconnecting J4.

- f. Momentarily short the screws across the left ribbon guide skids to cause the ribbon to run from right-to-left. Check to see that the ribbon is tracking centered in the left-hand ribbon guide.
- g. If the ribbon is not centered in the left-hand ribbon guide, loosen the ribbon guide holding screws but leave them snug enough to hold by friction (**Figure 82**). Pivot the guide on its locating pin (on top of the guide) so that the ribbon tracks in the center of the guide, then tighten the screws.
- h. Make sure that the ribbon is centered on the take up (left-hand) spool and that it winds without interference at the spool flanges.
- i. After completing the ribbon tracking adjustment at the left-hand guide, allow most of the ribbon to accumulate on the left spool. Momentarily short the right-hand ribbon guide skids to cause the ribbon to now move from left-to-right.
- j. Perform the preceding steps g and h for the right-hand guide.

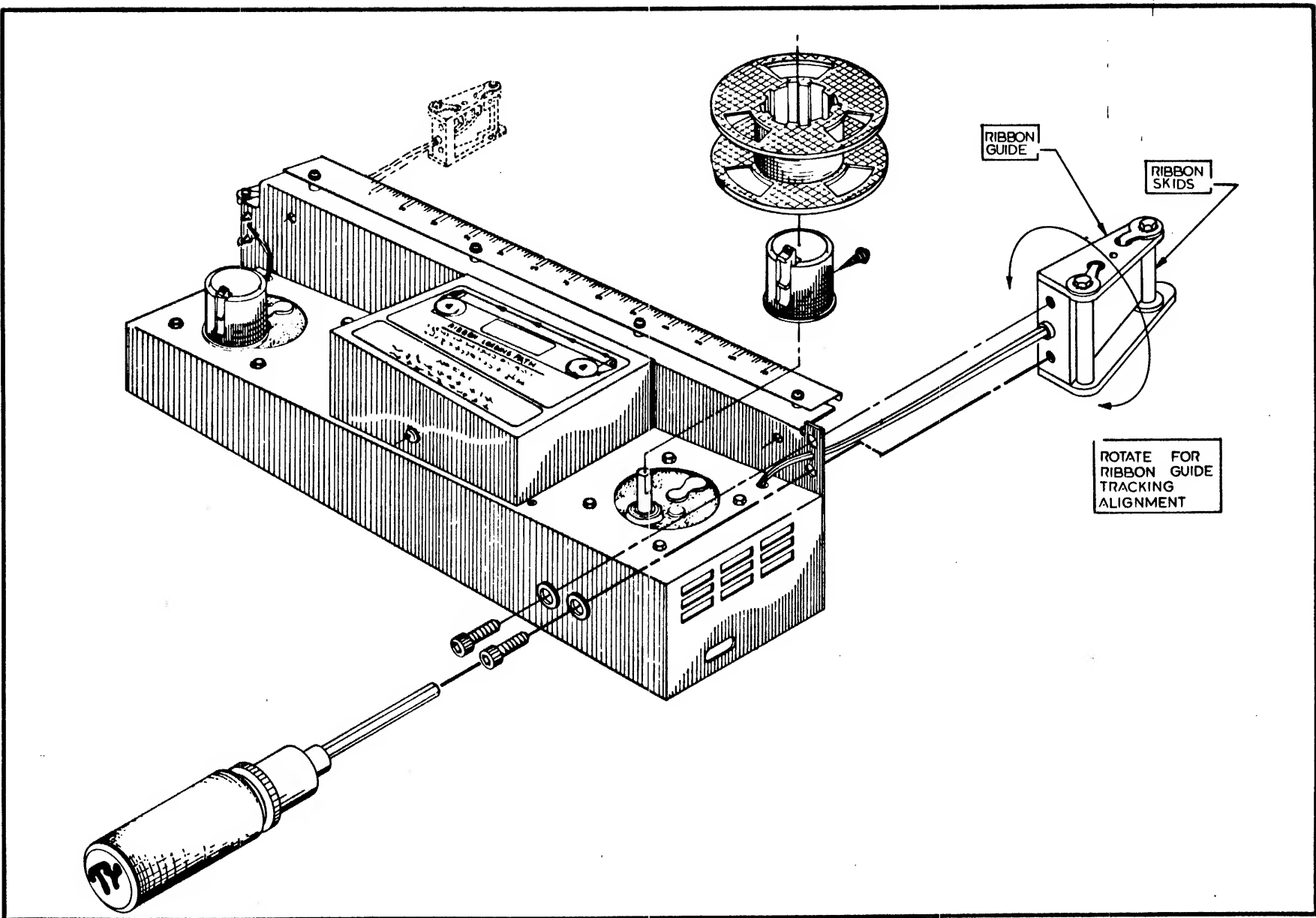


Figure 82 Adjusting a Ribbon Drive

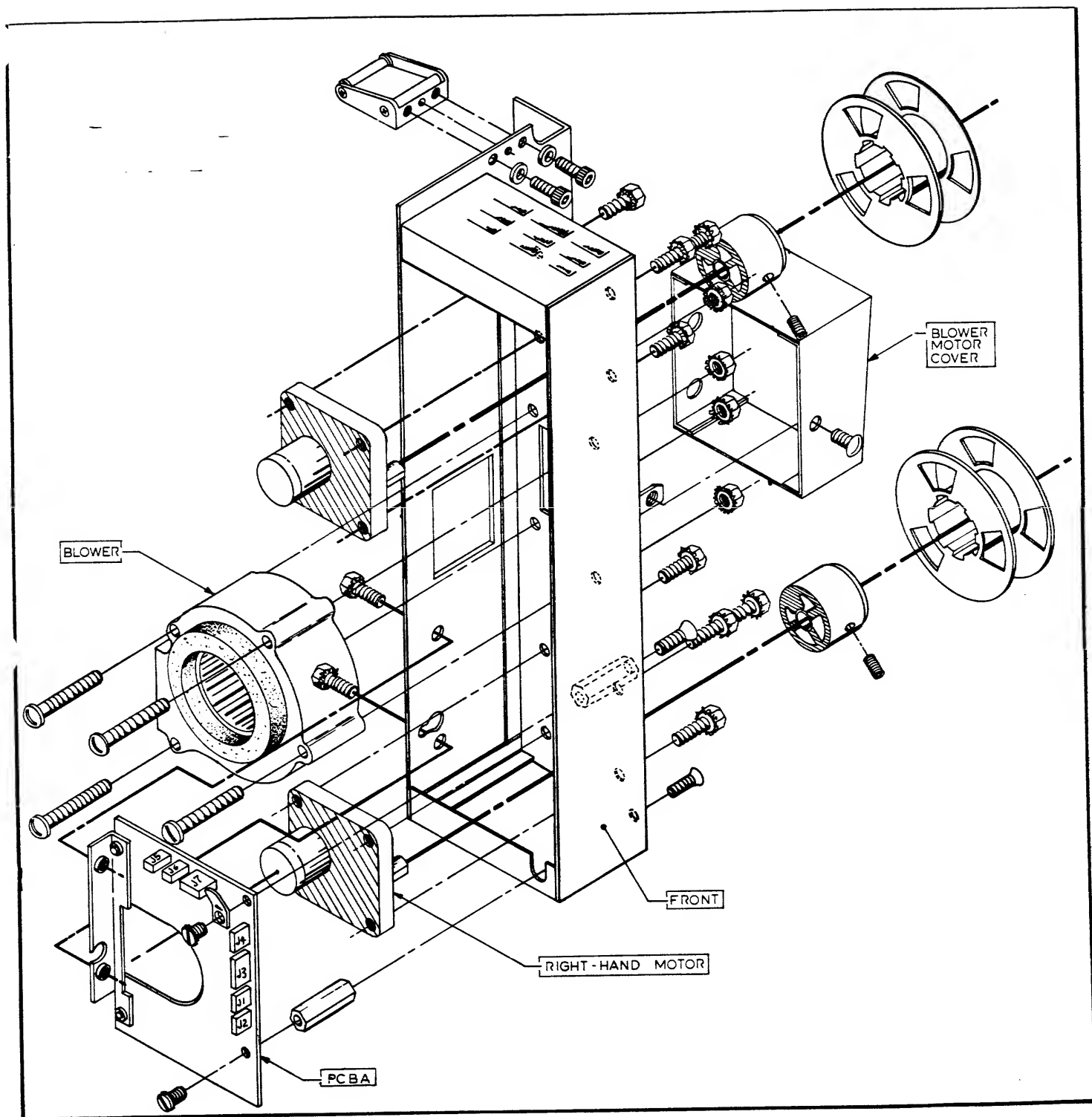


Figure 83 Ribbon Drive Assembly, Underside — Exploded View

- k. After adjusting the right-hand guide momentarily short the left-hand ribbon guide skids for ribbon motion from right-to-left. Recheck tracking at the left-hand guide and spool and readjust, if necessary.
- l. Be sure to allow the ribbon to unreel completely in both directions under the ribbon reversing controls. Verify proper tracking, spooling, and reversal action. Take corrective action, if necessary.
- m. When adjustments are completed; stop the printer, reconnect J4 on the Power Supply PCBA and restore the printer to normal operation.

5.10 REPLACING A RIBBON DRIVE MOTOR

To replace a failed Ribbon Drive Motor, refer to **Figure 83** and proceed as follows:

- a. Remove the Ribbon Drive Assembly per subsection 5.7.
- b. Loosen the hub set screw and remove the hub from the motor shaft.
- c. Disconnect the motor cable connector from the Ribbon Control PCBA, and cut any cable ties holding the cable.
- d. If the right-hand motor is to be replaced, remove the Ribbon Control PCBA from the Ribbon Drive Assembly per subsection 5.8.
- e. Remove the four screws that hold the motor to the Ribbon Drive Assembly chassis, then remove the motor.

NOTE

For Printronix Printer Serial Number C31579 and later,
remove four nuts instead of screws.

- f. Replace the motor by reversing the removal procedures. Replace the cable ties cut in step c.
- g. Reinstall the Ribbon Control PCBA (if it was removed in the preceding step d), per subsection 5.8.
- h. Replace the Ribbon Drive Assembly per subsection 5.7.

5.11 REPLACING THE RIBBON DRIVE ASSEMBLY BLOWER

To remove and replace the blower in the Ribbon Drive Assembly, refer to **Figure 83** and:

- a. Remove the Ribbon Drive Assembly from the printer per subsection 5.7.
- b. Remove the screw that holds the blower motor cover to the top of the Ribbon Drive Assembly.
- c. Invert the Ribbon Drive Assembly and remove the blower connector from the Ribbon Control PCBA.
- d. Remove the four nuts and washers on top of the Ribbon Drive Assembly that hold the blower to the chassis. Then remove the motor, shroud, and screws.

NOTE

For Printronix Printer Serial Number C31579 and later, remove the fan through the top of the Ribbon Drive Assembly. No mounting hardware is used.

- e. Run leads of the new blower through the hole on top of the Ribbon Drive Assembly. Install the new blower on the assembly, using screws, nuts, and washers removed in step d above.
- f. Connect the blower connector to its mating connector on the Ribbon Control PCBA.
- g. Replace the blower motor cover on top of the Ribbon Drive Assembly, and secure it with the screw removed in step b above.
- h. Replace the Ribbon Drive Assembly in the printer per subsection 5.7.

5.12 THE PRINTING MECHANISM

The printing mechanism comprises the following:

- a. The shuttle motor and belt.
- b. The Flywheel Assembly.
- c. The Hammer Bank Assembly.
- d. The shuttle mechanism and its bearing blocks.
- e. The Magnetic Pickup (MPU) and its mounting arm.

Although the Hammer Bank Assembly and the Flywheel Assembly may be serviced with the printer cover in place, other maintenance procedures may require that the printer cover be removed.

5.13 ADJUSTING PLATEN TO HAMMER TIP SPACING

In order to obtain correct and uniform print density, the gap between the platen and the hammer tips must be made very uniform. To check and/or adjust platen to hammer tips spacing (gap) refer to **Figure 84** and proceed as follows:

- a. Turn off the AC power and remove the paper from the printer.
- b. Set the Forms Thickness Lever to the LOAD position.
- c. Mount the Ribbon Drive Assembly in the service position per subsection 5.7 and read the following caution before continuing.

CAUTION

Carbide hammer tips are more susceptible than steel tips to breakage from lateral stress. Use care to raise the cover holes free of the tips before the cover is withdrawn from the shuttle.

- d. Remove the Hammer Bank Cover Assembly (**Figure 84**) as follows (Do not rotate the hammer bank into the service position):
 1. Force the top edge of the hammer bank cover forward and away from the hammer springs.
 2. Place your thumbs as far down as possible between the cover and the hammer bank.
 3. Push forward with your thumbs and simultaneously pull back with your fingers to release the cover from the magnetic force and the roll pins.
 4. Carefully lift the cover straight up.
- e. Measure the platen gap as follows:
 1. Insert a 0.012 inch feeler gauge between the platen and hammer tips somewhere within six hammer positions of one end of the hammer bank.

CAUTION

Be sure that the gauge does NOT bend or interfere with the paper ironer.

2. Carefully move the Forms Thickness Lever to the fully closed position. (**DO NOT FORCE** it into position against the feeler gauge.) The gauge should move with very little friction between the surfaces and lie in contact with both. To be sure that the gauge is vertical in both the lateral and front-rear positions, shift it slightly until minimal friction is encountered.

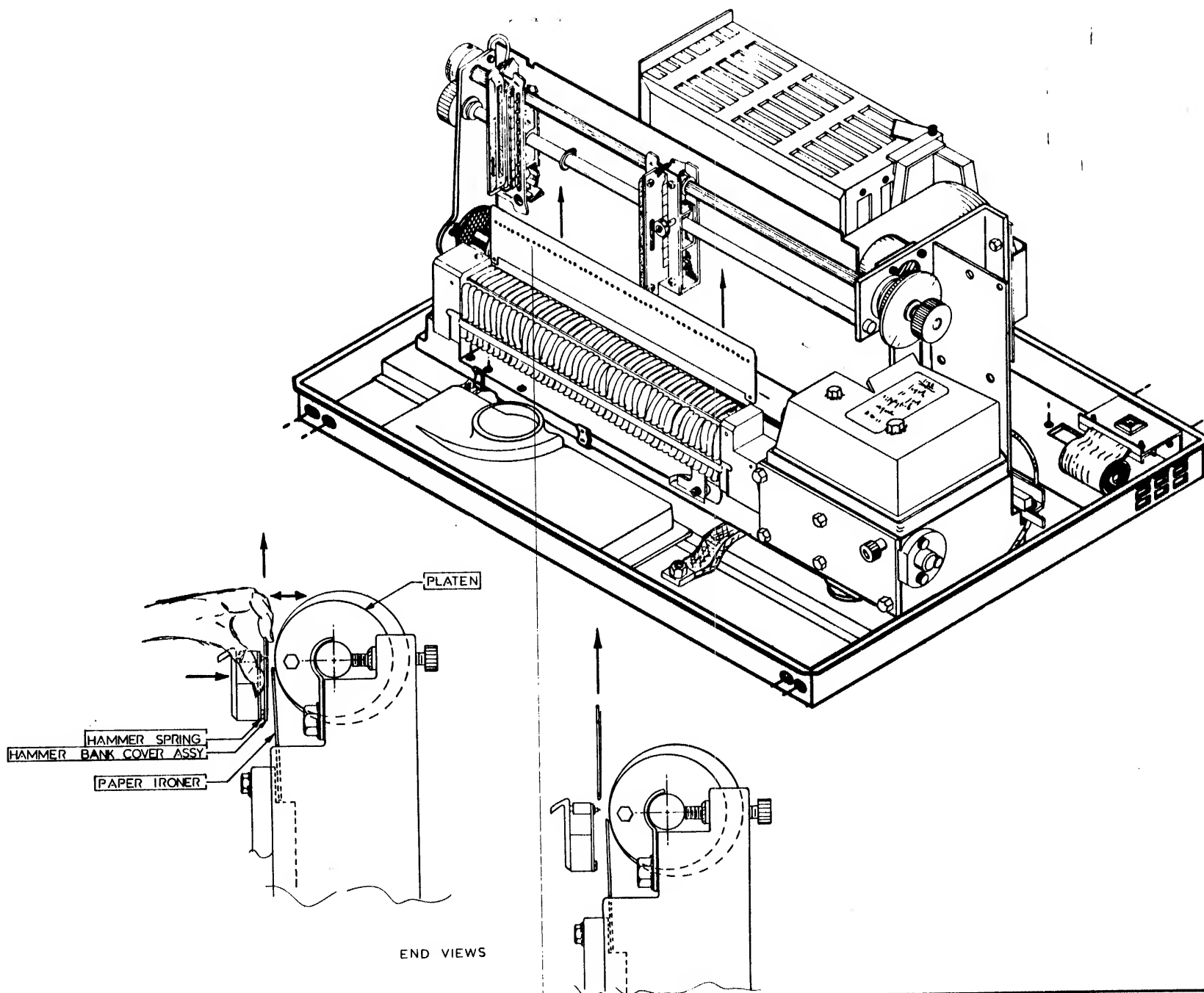


Figure 84 Removing the Hammer Bank Cover Assembly

- f. Repeat the gap measurement within six hammer positions of the other end of the hammer bank.
- g. Correct a gap measurement by adjusting the platen shaft support bolt at that end of the base casting (**Figure 85**). Rotate the bolt counter clockwise to increase the gap, or clockwise to decrease the gap. A rotation of a quarter turn results in an approximate 0.007 inch gap change.

NOTE

Access to the bolts is through the rear door of the printer. A 5/32 inch Allen socket wrench on a 12 inch extension is required to rotate the bolts.

- h. Check both ends of the platen after an adjustment. An adjustment at one end will slightly alter the other end.
- i. When the gap at both ends is correctly adjusted, replace the Hammer Bank Cover Assembly onto the roll pins using the same caution stated previously, replace the Ribbon Drive Assembly per subsection 5.7 and restore the printer to normal operation.

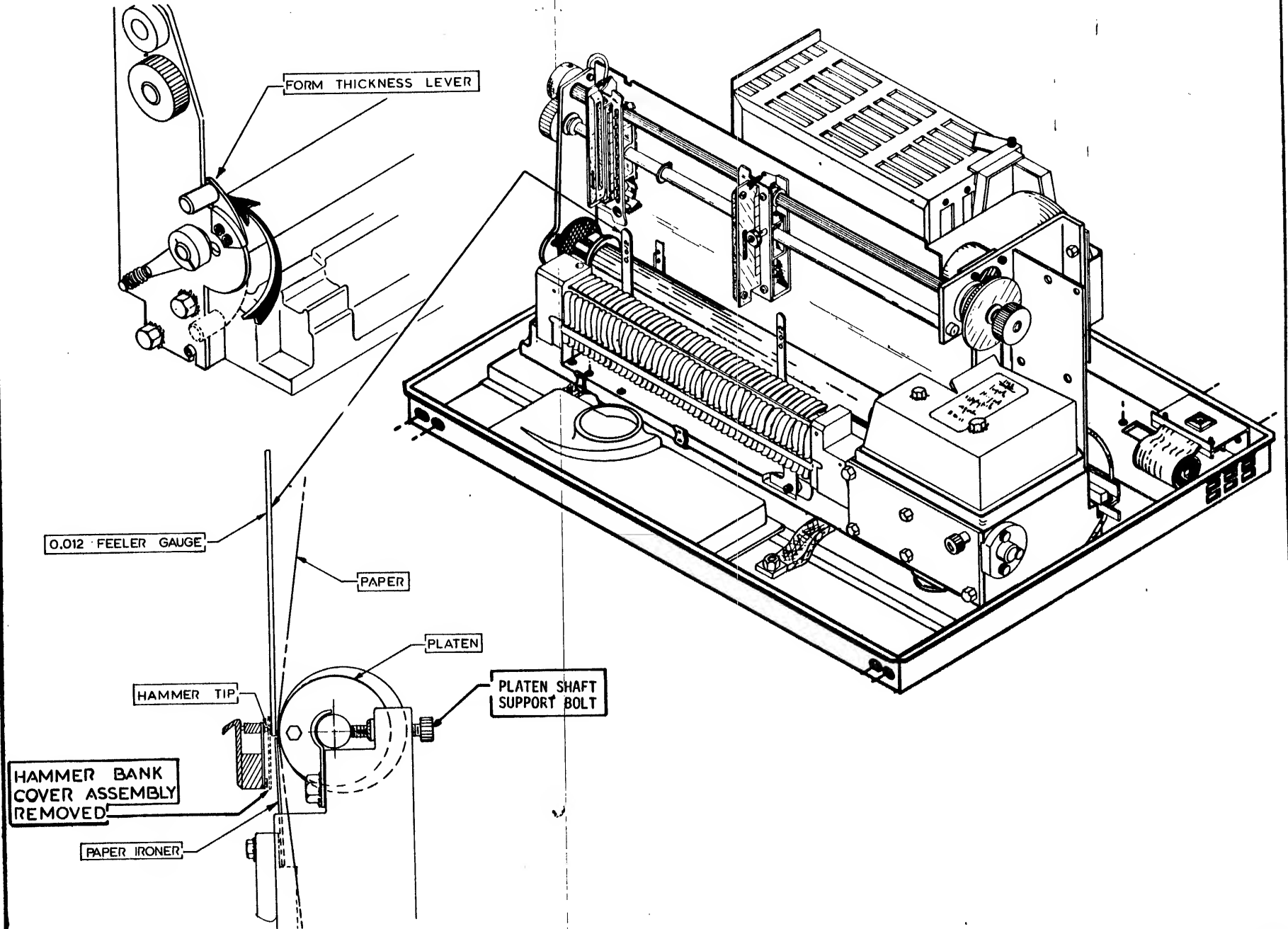
5.14 REMOVING THE ANTI-ROTATION ARM

The anti-rotation arm must be removed in order to rotate the hammer bank for cleaning or other maintenance.

To remove the anti-rotation arm, proceed as follows:

- a. Turn off the AC power.
- b. Set the Forms Thickness Adjustment lever to the Load position (fully raised) and remove any paper from the printer.
- c. Mount the Ribbon Drive Assembly in the service position per subsection 5.7.
- d. Loosen the two 5/32 inch Allen head screws that retain the wire comb bracket (**Figure 86**); then raise the comb bracket to free it from the screws.
- e. Disconnect the four coil wire socket connectors located under the hammer bank. Use care to disconnect them so no stress occurs to the wires.
- f. Move the comb bracket upward to allow access to the two 3/32 inch Allen head screws that hold the anti-rotation arm; then remove those two screws.

Figure 85 Adjusting Platen Spacing



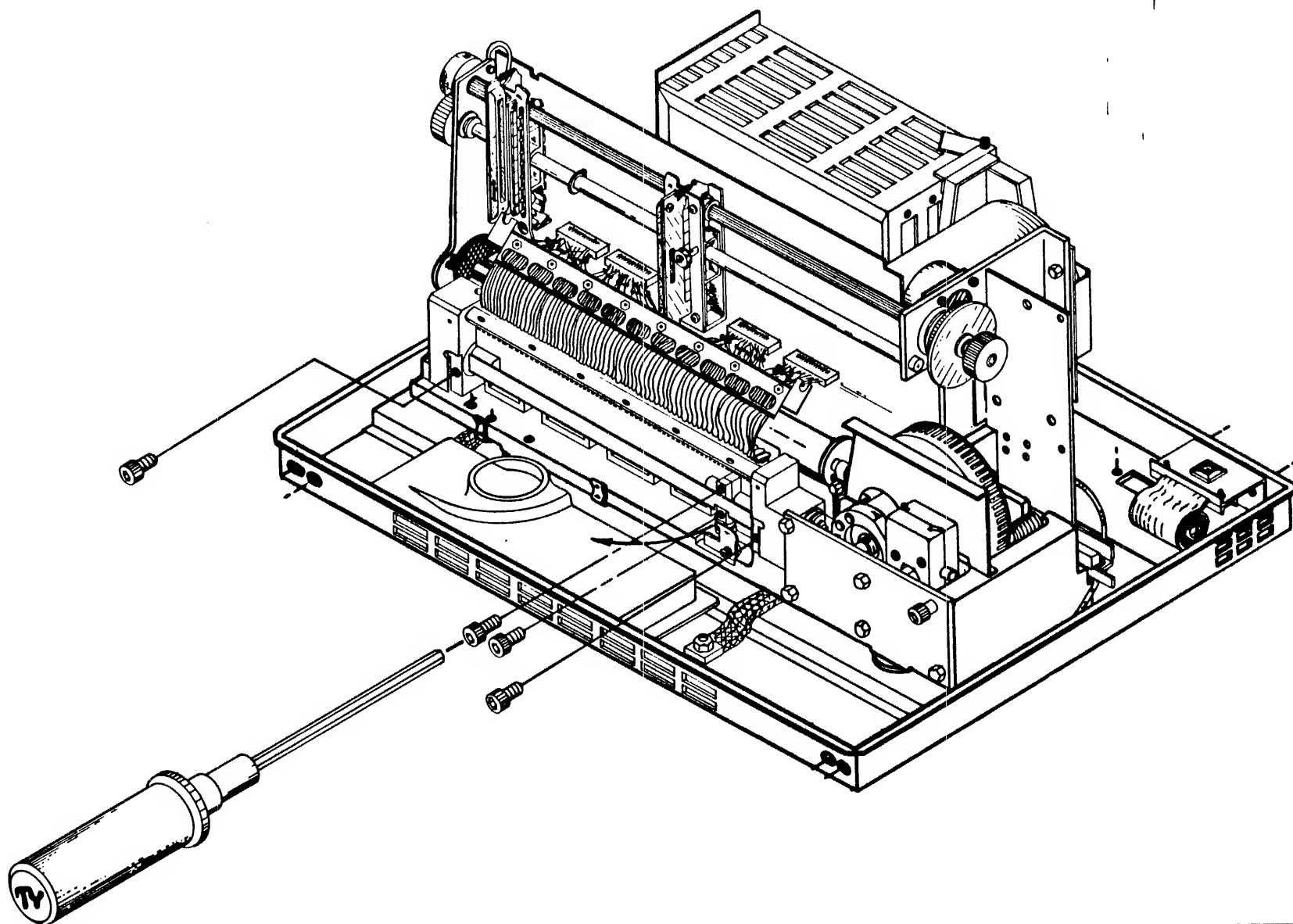


Figure 86 **Removing the Antirotation Arm**

NOTE

It is optional whether the front tension spring bolt should be loosened. **DO NOT** disturb the anti-rotation pin and support plate screws at the rear where the ball bearing races ride.

- g. Remove the anti-rotation arm. Move it upward with a slight left slant to clear the front tension springs and then downward out of the shuttle frame at the bottom.

To replace the anti-rotation arm, proceed as follows:

- a. Replace the anti-rotation arm in its normal position; then install the two screws removed in Step f above. Torque the screws using a torque wrench set at 12 inch pounds.
- b. Reconnect the four hammer coil connectors. Align each in its mating connector so that no male pins are visible on either side of the connector.
- c. Place the comb bracket screw slots over the two loosened Allen head screws on the bearing blocks. Engage them into the slots and tighten those screws.
- d. Replace the Ribbon Drive Assembly per subsection 5.7 and restore the printer to operation.

5.15 ROTATING THE HAMMER BANK INTO THE SERVICE POSITION

It is necessary to rotate the hammer bank (**Figure 87**) toward the front of the printer in order to service it.

CAUTION

Do not attempt to rotate the hammer bank without first loosening the shuttle bearing clamp bolts. Bearings may be damaged by rotating the hammer bank without first loosening bearing clamping tension.

To rotate the hammer bank, perform the following steps:

- a. Turn off the AC power.
- b. Set the Forms Thickness Adjustment lever to the load position (fully raised) and remove any paper from the printer.

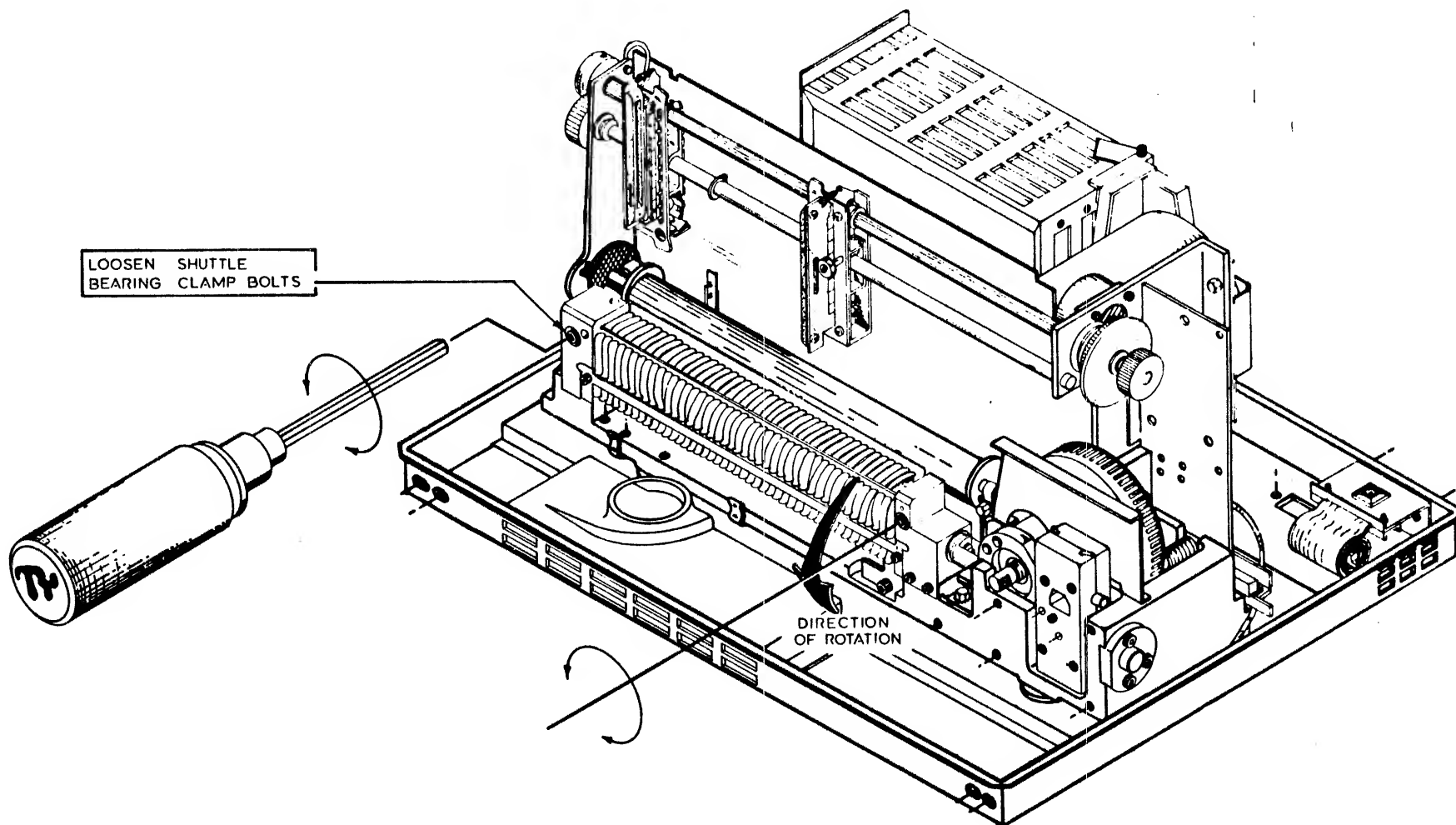


Figure 87 Hammer Bank Assembly Rotated to Service Position

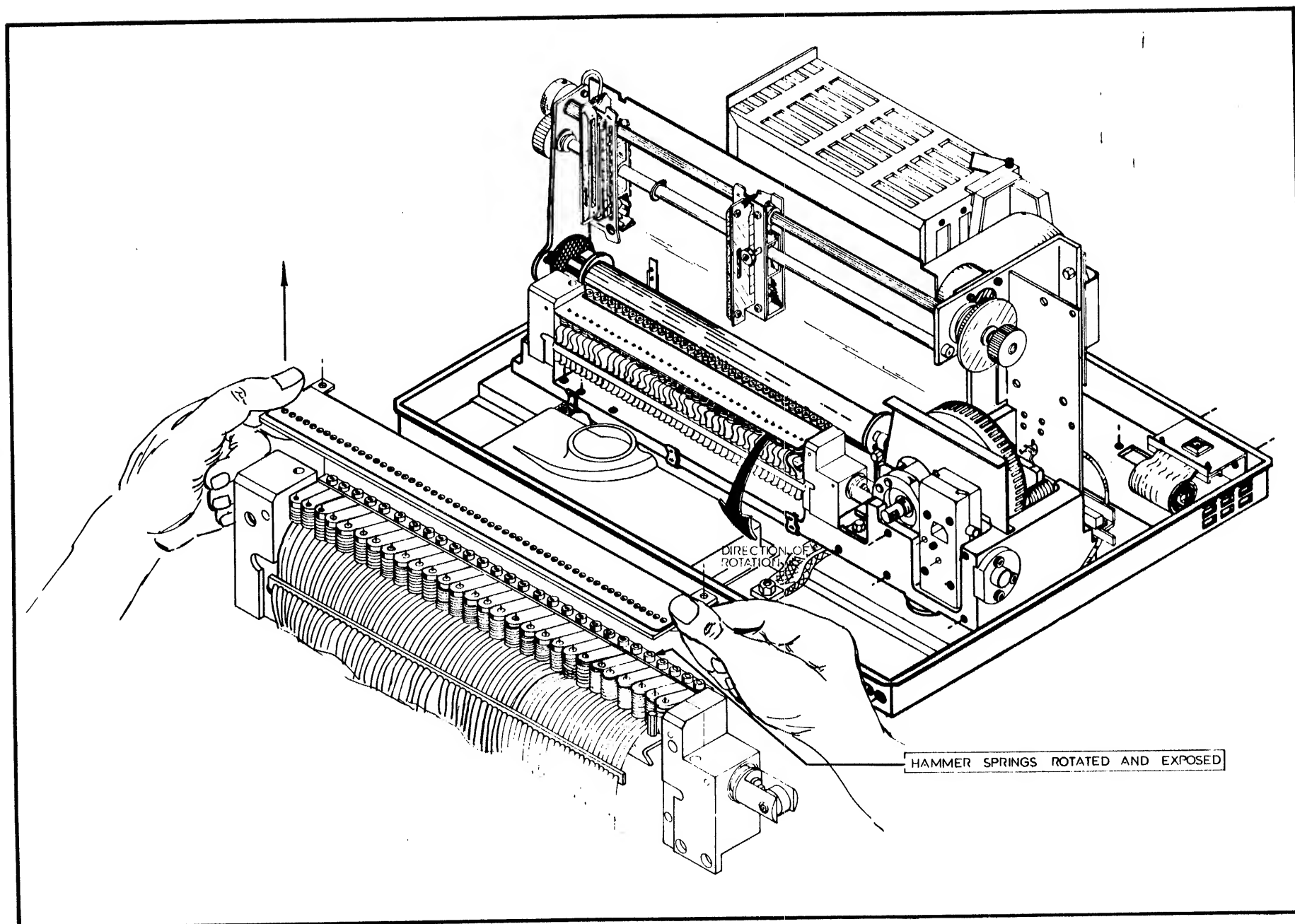


Figure 88 Removing the Hammer Bank Cover Assembly

- c. Mount the Ribbon Drive Assembly in the service position per subsection 5.7.
- d. Remove the anti-rotation arm, per subsection 5.15.
- e. Loosen the Allen head bearing clamp bolts about a quarter turn (**Figure 87**).
- f. Force the Hammer Bank Assembly slightly to the left to avoid damage to the Hammer Bank Cover Assembly. Rotate the Hammer Bank Assembly toward the front of the printer.
- g. Carefully lift the ends of the Hammer Bank Cover Assembly from the roll pins in the shuttle and lift it out (**Figure 88**). Because the assembly will tend to stick to the magnetized shuttle, be careful not to bend it at the roll pins.

CAUTION

Carbide hammer tips are used in the hammer bank. Be especially careful when removing or replacing the Hammer Bank Cover Assembly or performing other procedures in the hammer bank area. The carbide tips may be chipped or broken off if excess lateral force is applied to them.

To restore the Hammer Bank to its operating condition after maintenance procedures have been completed, perform the following steps:

- a. Rotate the hammer bank back to its operating position.
- b. Replace the anti-rotation arm, per subsection 5.14, but do not replace the Ribbon Drive Assembly.
- c. Turn on the AC power. Start the printer shuttling by depressing the ON LINE pushbutton.

CAUTION

Torquing the bearing clamp bolts to an incorrect value or attempting to torque the bolts while the shuttle is in an idle condition may result in serious damage to the shuttle bearings.

- d. While shuttling, torque the bearing clamp bolts using a torque wrench set at 36 inch pounds. Recycle the ON LINE pushbutton off and on to continue the shuttling action.

- e. Turn off the AC power.
- f. Verify the hammer tip to platen gap adjustment per subsection 5.13 and adjust, if necessary.
- g. Replace the Hammer Bank Cover Assembly fitting the holes in its ends over the roll pins in the shuttle. Observe the caution concerning carbide tips.
- h. Replace the Ribbon Drive Assembly per subsection 5.7; then restore the printer to normal operation.

5.16 REPLACING A HAMMER SPRING

To replace a failed or damaged hammer spring, proceed as follows:

- a. Mount the Ribbon Drive Assembly in the service position per subsection 5.7. Rotate the Hammer Bank Assembly and remove the Hammer Bank Cover Assembly per subsection 5.15.
- b. Determine whether the hammer is to be replaced or merely adjusted.
 - 1. For hammer replacement remove the 3/32 inch Allen head screw holding the damaged hammer spring and loosen the 3/32 inch Allen screw sharing the same clamp plate. Proceed to step c below.
 - 2. If only a hammer adjustment is to be made, loosen the two screws holding the clamp plate above the hammer to be adjusted and the adjacent hammer; then proceed to step e, below.
- c. Remove the hammer spring by sliding it forward over the coil pole pin.

CAUTION

Handle new hammer springs carefully. Transport springs flat and unstressed.

- d. Install the new hammer spring and cover it with the clamp plate (round surfaces up). Replace (but do not tighten) the hammer spring screw removed in step b. Be sure that the mounting surfaces and the coil pin are clean and free of chips, burrs, oil, etc.

CAUTION

Use only the specified screw to hold the hammer spring. Any other type of screw may damage the Hammer Bank Assembly.

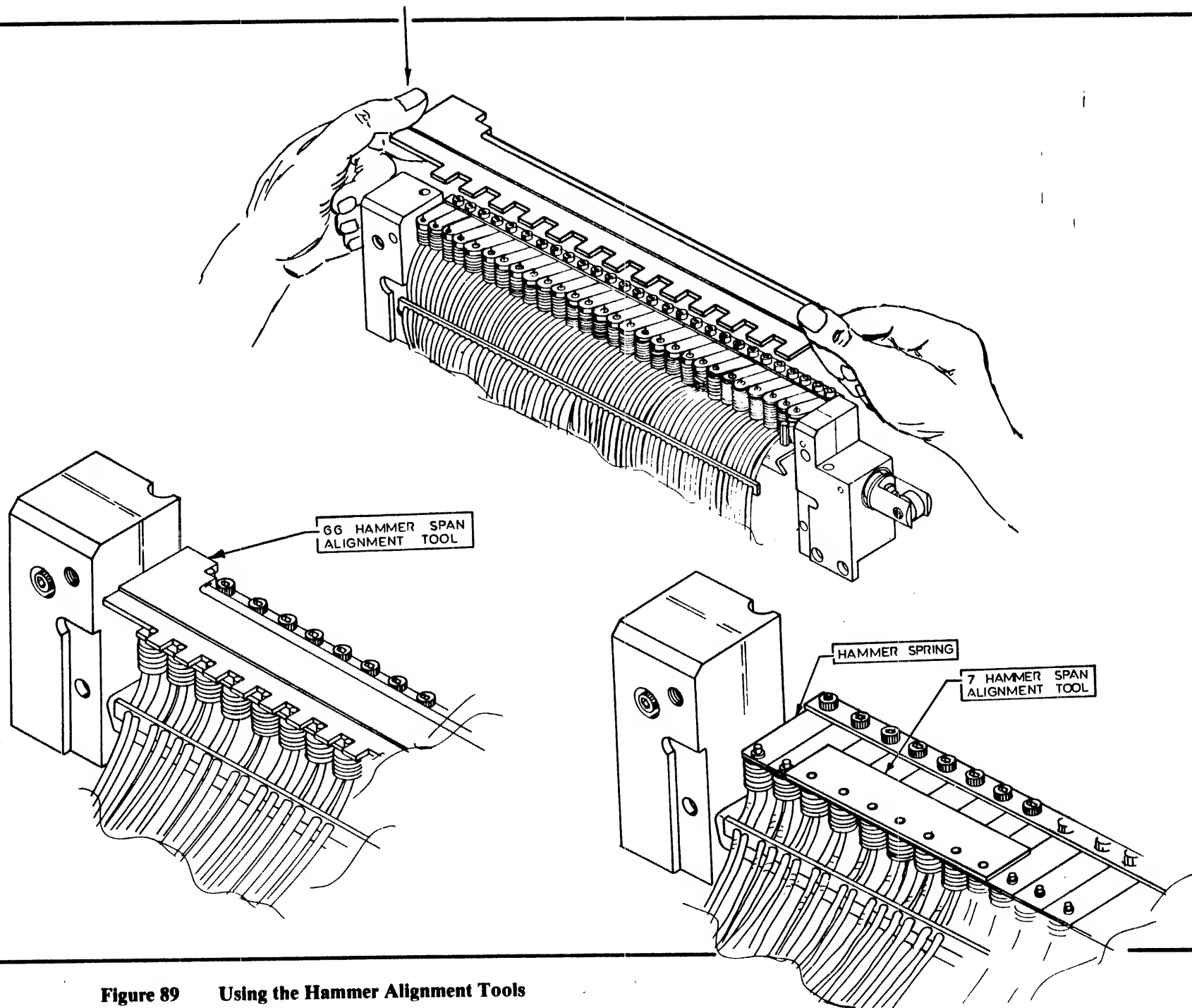


Figure 89 Using the Hammer Alignment Tools

- e. Fit holes in the hammer alignment tool (**Figure 89**) over hammer tips on either side of the hammer spring being replaced. Position the tip of the hammer spring so that the tip fits into its respective hole in the tool.

CAUTION

Carbide hammer tips may be chipped or broken off by too much lateral force. Be especially careful when using the hammer alignment tool.

- f. Torque the hammer spring screws on the clamp plate using a torque screwdriver set at 12 inch pounds. Correct torque is essential for proper printer operation. Remove the alignment tool carefully so the hammer tips are not damaged.

CAUTION

While torquing hammer bank screws, hold the clamp plate in position to be sure it remains perpendicular to the hammer springs and does not extend beyond the edge of the Hammer Bank Assembly.

- g. Following the procedures in subsection 5.15, rotate the hammer bank into its normal operating position.
- h. Check the gap between hammer tip and platen per subsection 5.13; adjust if necessary.
- i. Replace the Hammer Bank Cover Assembly. Observe the caution concerning carbide tips.
- j. Replace the Ribbon Drive Assembly per subsection 5.7.

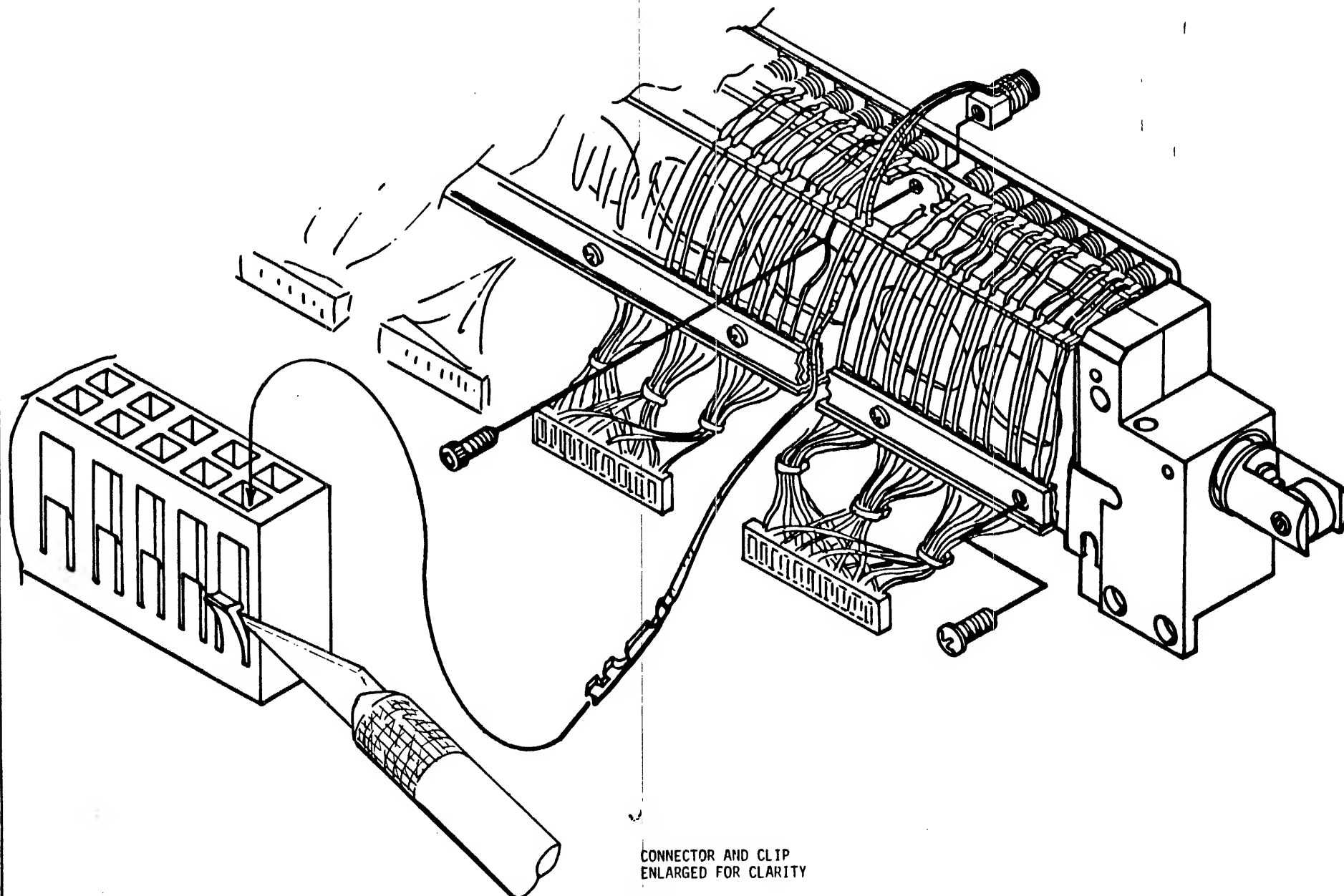


Figure 90 Removing the Hammer Coil

5.17 REPLACING A HAMMER COIL

Each hammer coil is integral with its pole pin and mounting base. The coil is secured to the Hammer Bank Assembly by means of a screw which is accessible while the hammer bank is in its normal operating position.

- a. Mount the Ribbon Drive Assembly in the service position per subsection 5.7.
- b. Loosen the two 5/32 inch Allen head screws that retain the wire comb bracket (**Figure 85**).
Raise the comb bracket to free it from the screws.
- c. Remove the 3/32 inch Allen head screw holding the defective coil (**Figure 90**).

NOTE

A unique shim is placed behind each pair of pole piece coil assemblies. Observe caution that the shim is not displaced.

- d. Remove the coil leads.

CAUTION

**Handle the coil carefully to avoid damage to adjacent coils.
Do not stress the hammer spring while removing the coil.**

- e. Remove the two coil leads from the upper comb: grasp each individual lead between the thumb and forefinger and gently pull the leads out of the comb.
- f. Remove the four screws from the related wire clamp on the comb bracket (**Figure 90**) and release the coil wires from the bracket.
- g. Disconnect the related coil connector (one of four located below the hammer bank).
- h. Disconnect each of the leads of the defective coil from the connector (**Figure 90**) as follows:
 1. Lift the connectors plastic releasing catch over the lead terminal (using an Xacto knife or other pointed tool).
 2. Withdraw the lead and its terminal.

CAUTION

The connector releasing tab may be damaged by excessive flexing during lead removal. Lift the tab only far enough to release the lead terminal.

To install the replacement coil, proceed as follows:

- a. Position the replacement coil under the hammer spring. Be careful not to stress the hammer spring. Observe that the shim underneath this and the adjacent coil has not shifted position or fallen out.
- b. Insert the mounting screw into the coil to hold it in place, but do not tighten the screws.
- c. Carefully align the coil and its mounting screw with the hammer spring and the adjacent coils.
- d. Torque the coil mounting screw, using a torque screwdriver set at 12 inch pounds.
- e. Insert each lead of the replacement coil into the coil lead connector. Make sure the lead is locked in by the releasing catch and the lead colors match those of the other coils.
- f. Dress the coil leads over the comb bracket and into their respective slots in the upper comb. Be sure to provide for a service loop matching that of the other leads in the comb.

CAUTION

Do not tighten wire clamp screws unless coil leads are dressed at least 3/16 inch from the screws. Pinched coil leads may result in damage to coils, hammer drivers, or both.

- g. Fasten the wire clamp on the comb bracket using the four screws removed in Step e above. Dress the coil leads at least 3/16 inch away from each of the four screws.
- h. Reconnect the coil lead connector with its mating connector under the Hammer Bank Assembly. Position the coil lead connector so that no male pins are visible to either side of the connectors.
- i. Place the comb bracket screw slots over the two loosened Allen head screws on the bearing block. Engage them into the slots and tighten those screws.
- j. Replace the Ribbon Drive Assembly per subsection 5.7.

k. Run performance tests to verify operation of the replaced coil.

1. If the print for the replaced coil is too light, tweak the hammer toward the platen and re-run the performance tests.
2. If the print for the replacement coil is too dark, proceed to step 1.
3. If the print is correct, return the printer to normal operation.

l. To tweak a too dark hammer,

1. Rotate the hammerbank to the service position per subsection 5.15 and remove the spring per subsection 5.16.
2. Grip the spring in a pair of longnose pliers so that the screw hole is just covered and tweak the spring in the direction opposite the hammer tip (**Figure 91**).
3. Replace the spring per subsection 5.16 and rotate the hammer bank to the normal position per subsection 5.15.

m. Repeat steps k. and l. until the print is correct.

5.18 REMOVING AND REPLACING THE SHUTTLE ASSEMBLY

A Shuttle Assembly needing replacement of a hammer spring or a hammer coil may be repaired in the field. The entire Shuttle Assembly must be replaced for other shuttle problems.

To remove the Shuttle Assembly, refer to **Figure 92** and proceed as follows:

- a. Set the Forms Thickness Adjustment lever to the LOAD position and mount the Ribbon Drive Assembly in the service position per subsection 5.7.
- b. Loosen the screw that holds the anti-rotation arm spring clip (**Item A, Figure 92**).
- c. Remove the right and left comb retaining screws (**Item B, Figure 92**).
- d. Disconnect the four hammer coil connectors from their mating connectors underneath the Shuttle Assembly.
- e. Loosen both bearing clamp bolt about one quarter turn (**Item C, Figure 92**).
- f. Loosen the screw holding the rear of each of the two bearing blocks (**Item D, Figure 92**). Note these screws are captive. Do not attempt to remove them from the Shuttle Assembly.
- g. Remove the left screws (**Item E, Figure 92**) at the bottom front of the right bearing block. Then remove the right screw (**Item F, Figure 90**) at the bottom front of the right bearing block.

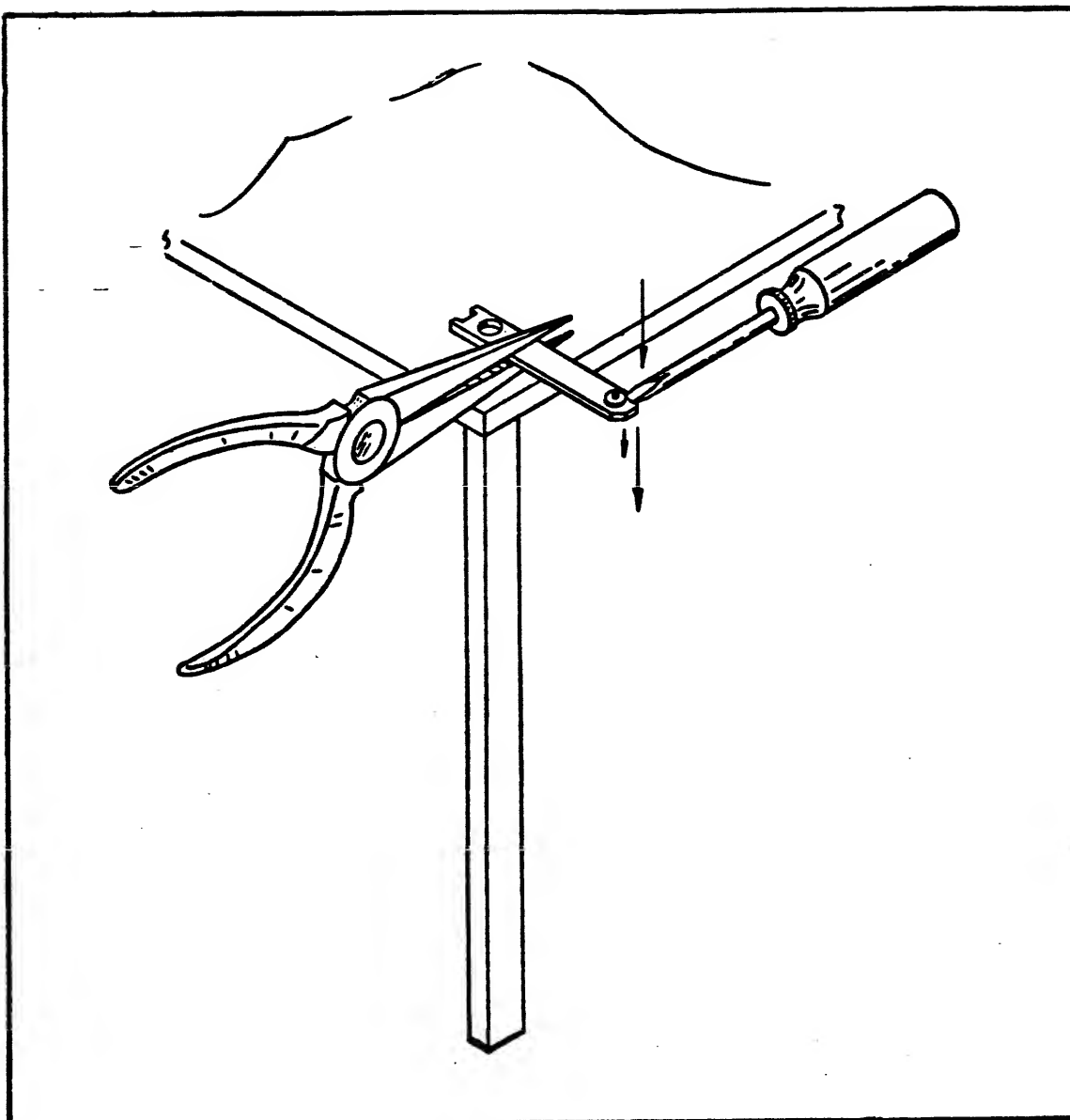


Figure 91 Tweaking the Hammer Spring

k. Run performance tests to verify operation of the replaced coil.

1. If the print for the replaced coil is too light, tweak the hammer toward the platen and re-run the performance tests.
2. If the print for the replacement coil is too dark, proceed to step 1.
3. If the print is correct, return the printer to normal operation.

l. To tweak a too dark hammer,

1. Rotate the hammerbank to the service position per subsection 5.15 and remove the spring per subsection 5.16.
2. Grip the spring in a pair of longnose pliers so that the screw hole is just covered and tweak the spring in the direction opposite the hammer tip (**Figure 91**).
3. Replace the spring per subsection 5.16 and rotate the hammer bank to the normal position per subsection 5.15.

m. Repeat steps k. and l. until the print is correct.

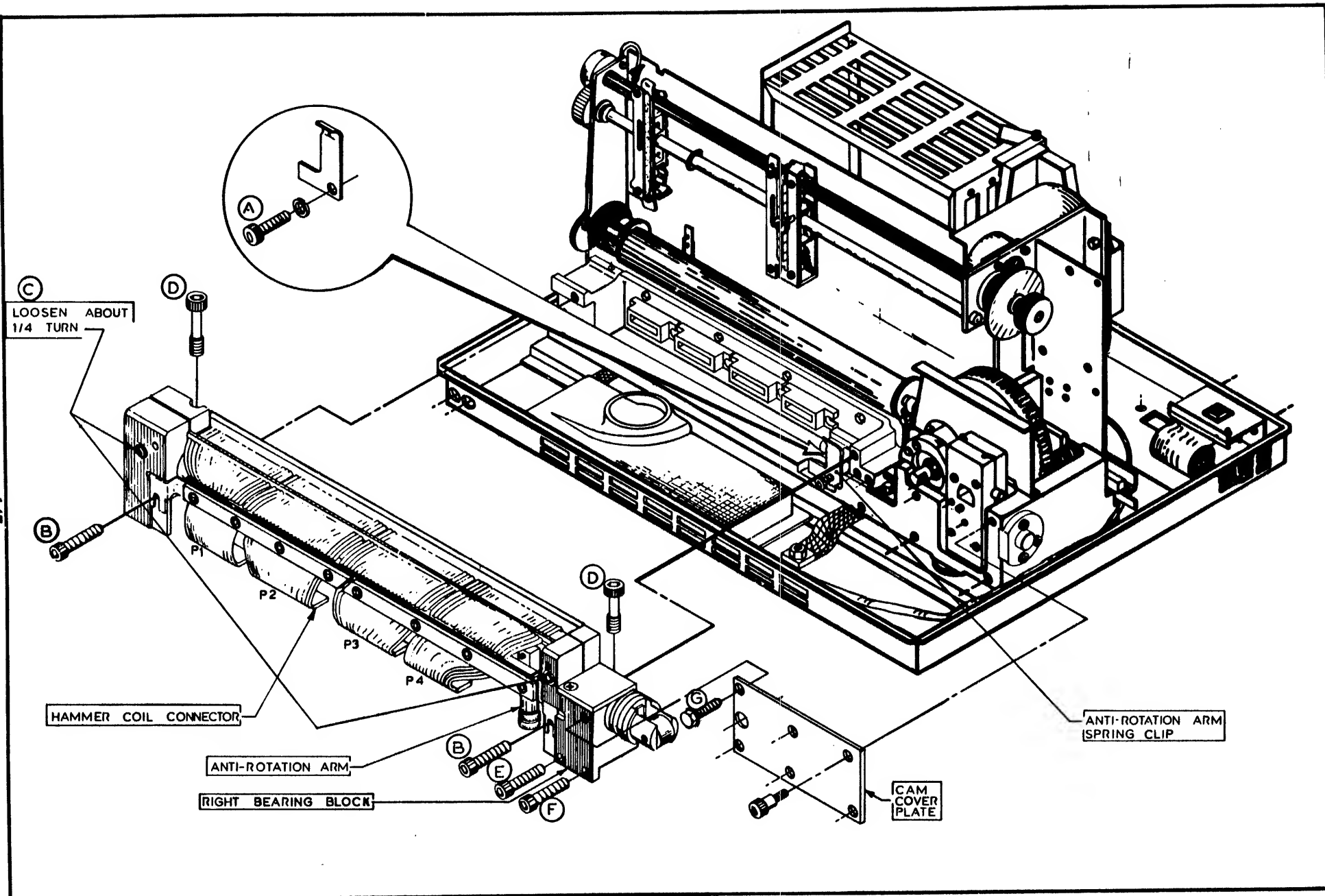


Figure 92 Removing the Shuttle Assembly

NOTE

Some early printers provide no access hole to this screw. The cam cover plate must be removed on these units.

- h. Remove the screw from **(Item G, Figure 92)** the upper left corner of the cover plate.
- i. Carefully lift the Shuttle Assembly, including its bearing blocks, from the printer.
- j. Retain the anti-rotation arm and mounting screws from the old assembly. They will be needed on the new assembly.

To install a new Shuttle Assembly, refer to **Figure 93** and proceed as follows:

- a. Mount the anti-rotation arm on the Shuttle Assembly with the flat surface of the arm against the Shuttle Assembly. Torque the two screws holding the anti-rotation arm to 12 inch pounds.
- b. Set the Shuttle Assembly in position on the printer casting, with the anti-rotation arm under the spring clip. Leave the spring clip loose.
- c. Insert and hand tighten all of the bearing block retaining screws **(Items A through D and F, Figure 93)**.
- d. Use two wrenches to simultaneously tighten both the rear left bearing block retaining screw and the left comb bracket screw **(Item B, Figure 93)**.
- e. Again using two wrenches, simultaneously tighten the two right bearing block screws **(Item C, Figure 93)**.
- f. Tighten the remaining right bearing block retaining screws **(Items A and F, Figure 93)**.
- g. Loosen both of the comb bracket screws **(Items B and D, Figure 93)**.
- h. Connect each of the four hammer coil connectors to its mating connector. Align each so that no male pins are visible on either side of the connector.
- i. Put the comb brackets in place and tighten their retaining screws **(Items B and D, Figure 93)**.
- j. Torque the anti-rotation arm retaining clip to 12 inch pounds.
- k. Adjust the platen gap per subsection 5.13.
- l. Insert paper in the printer, reconnect the AC power, turn the power switch on ON, and press the ON LINE pushbutton.
- m. While the shuttle is operating, torque each bearing clamp bolt **(Item E, Figure 93)** to 36 inch pounds. Recycle the ON LINE pushbutton off and on to continue the shuttle action.
- n. Replace the Ribbon Drive Assembly per subsection 5.7.

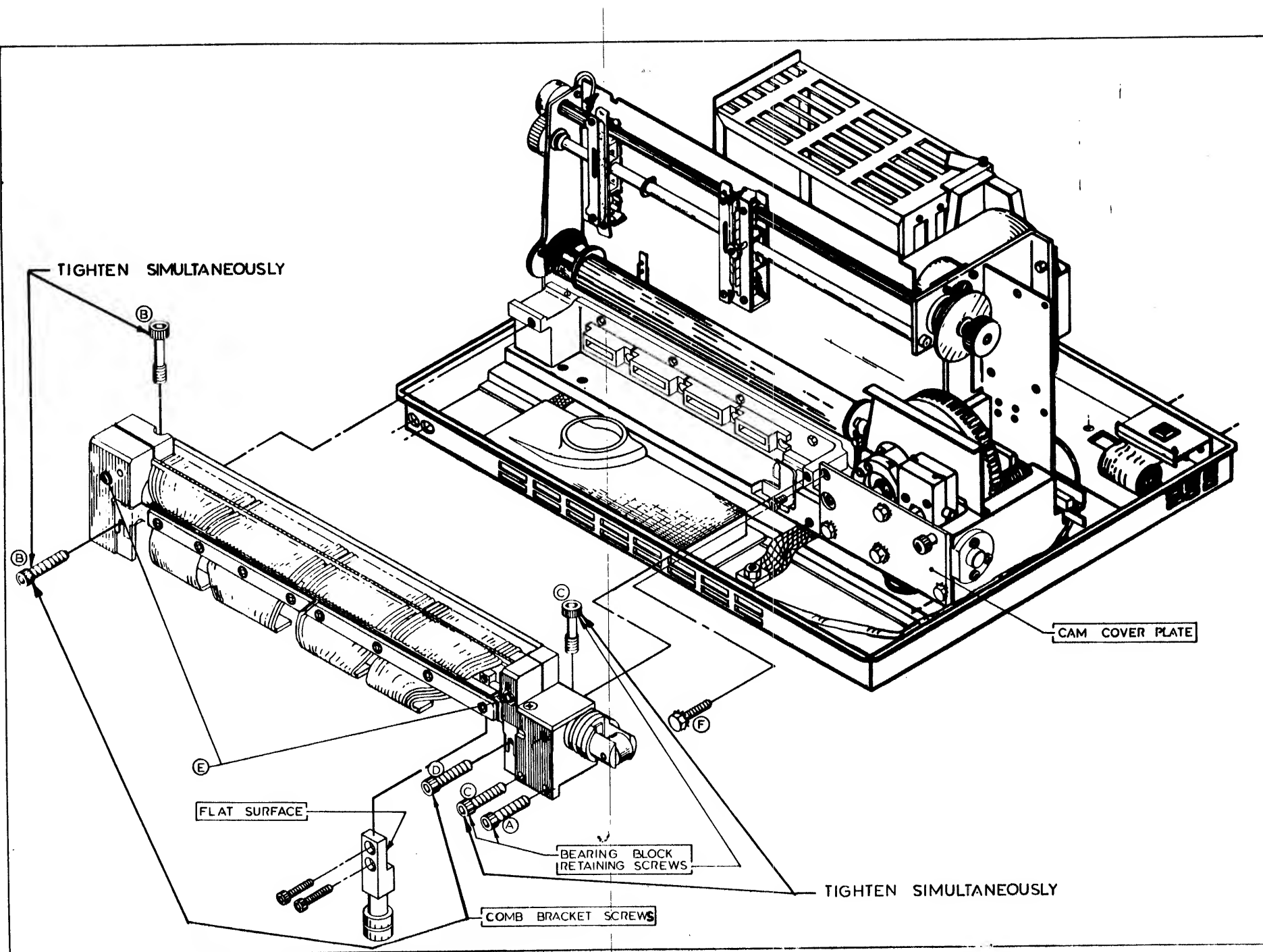


Figure 93 Installing the Shuttle Assembly

5.19 SHUTTLE SPRING FORCE PROBLEMS

Excessive rattle under the cam cover may be eliminated as follows:

NOTE

Although this subsection compensates spring forces and reduces rattle, the absolute amount of spring force is not determined. Incorrect spring force may result in impaired print quality. If these techniques do not eliminate the rattle, obtain the assistance of a qualified Printronix service person in your area.

- a. Remove the screws and washers holding the cam cover. Be sure to wipe any metal chips off the cover.
- b. Remove the cam cover with its gasket.
- c. Check the area under and around the shuttle spring for any shims that may have broken or fallen from the Shuttle Assembly. Replace any broken or loose shims per step f or g. When all shims are in place, turn on power to the printer.
- d. Put the printer ON LINE so that the shuttle operates. Recycle the ON LINE switch off and on to continue the shuttle action.
- e. Apply heavy pressure to the right side of the counterweight (**Figure 94**).
 1. If the rattle increases, add a shim against the shuttle spring, following step f.
 2. If the rattle decreases, add a shim against the counterweight spring, following step g.
- f. Insert a 0.01 inch shuttle spring shim (P/N 101565-001) between the cam follower yoke and the shuttle spring (**Figure 94**) as follows:
 1. Use a sharp screwdriver to pry the spring away from the yoke.
 2. Insert the shim and press down on the shim until it is flush with the yoke. More than one shim may be required to obtain the required effect.
- g. Insert a 0.01 inch counterweight spring guide shim (P/N 101564-001) between the side of the base casting and the spring seat plate as follows (**Figure 95**):
 1. Loosen the holding screw in the side casting approximately three turns.
 2. Press on the screw head with the Allen wrench against the spring tension in order to shift the seat plate to the left away from the casting and allow the shim(s) to be installed.
- h. Turn off the power to the printer and replace the cam cover and gasket.

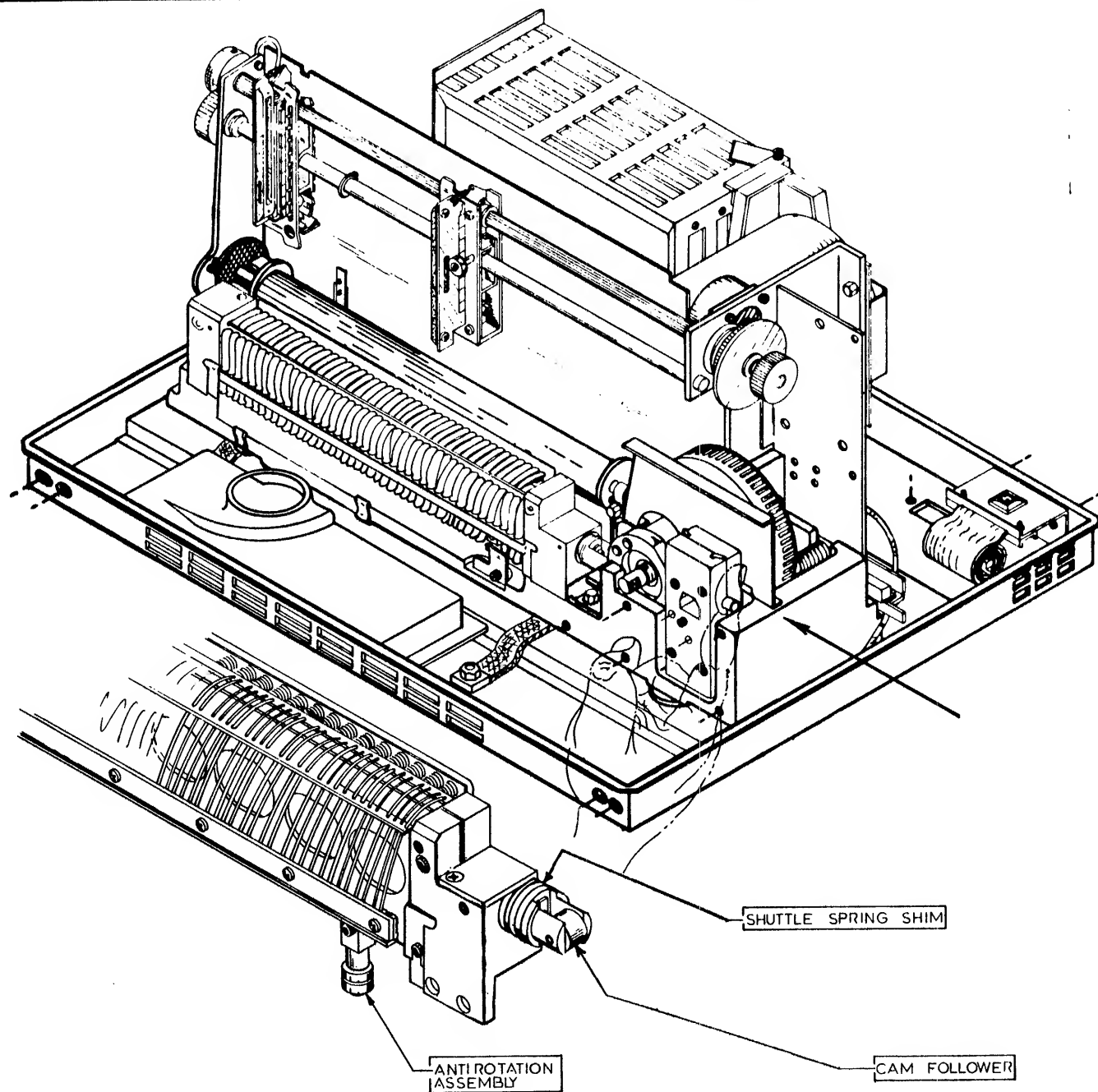


Figure 94 Checking Shuttle Spring Force

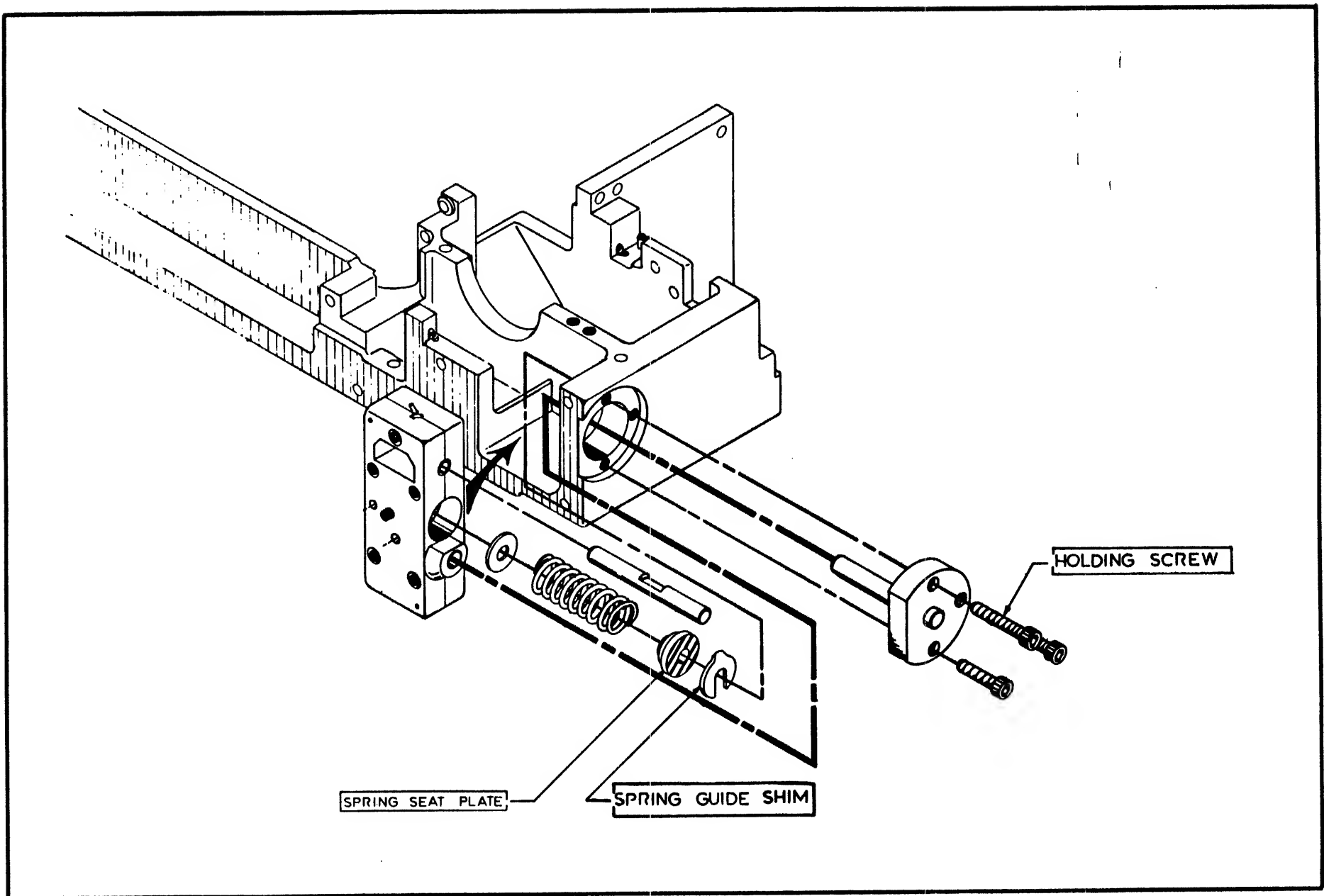


Figure 95 **Location of the Counterweight Spring Guide Shim**

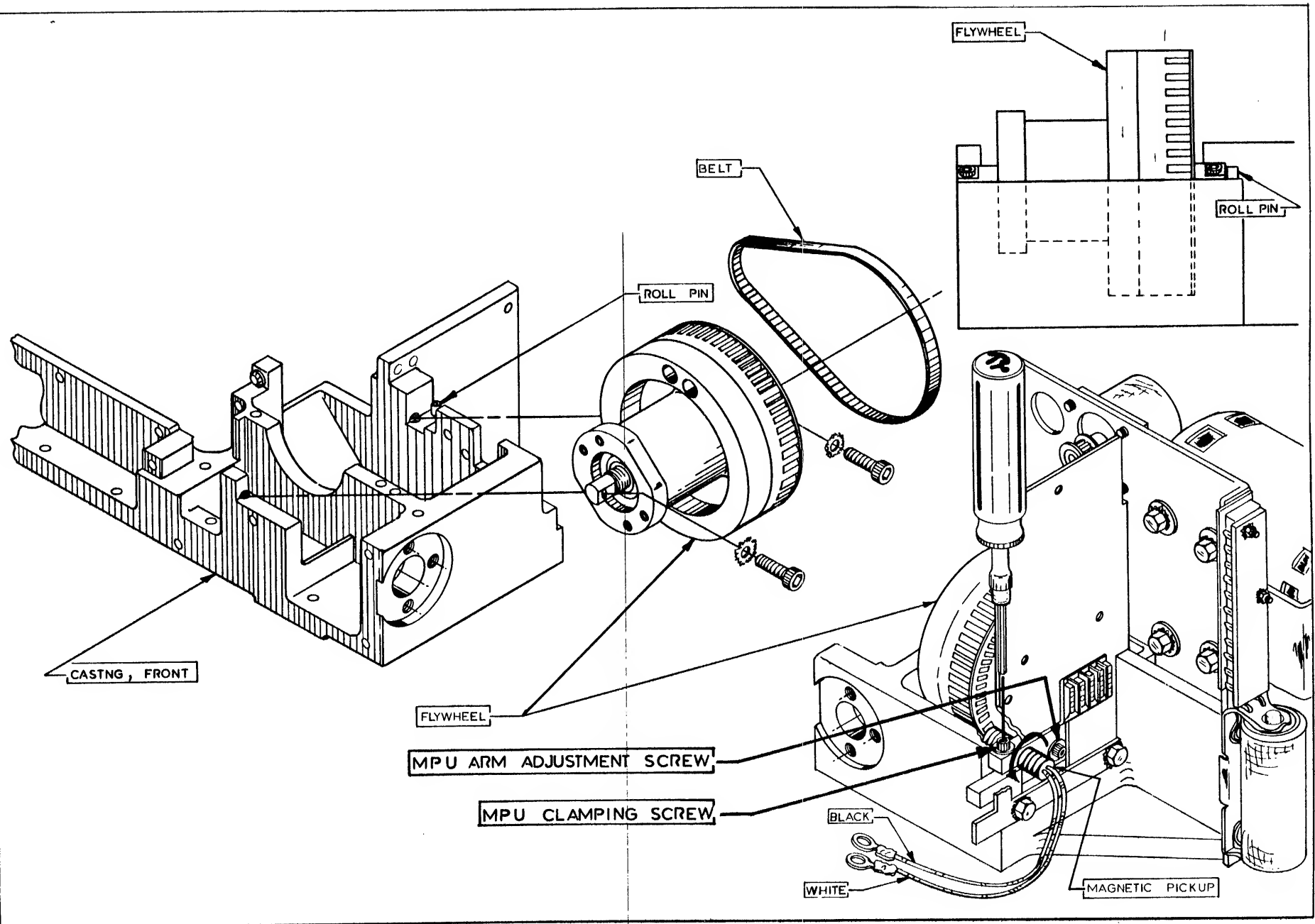


Figure 96 Positioning the Flywheel Shaft

5.20. ADJUSTING THE SHUTTLE BELT TENSION

The shuttle belt must be tensioned correctly when mounted on the shuttle motor pulley and the flywheel. The belt should appear taut and deflect approximately 1/4 inch under some finger pressure. To adjust the belt for correct tension, proceed as follows:

- a. Loosen the screws that hold the shuttle motor to its mount.
- b. Adjust the motor up or down until the shuttle belt is correctly tensioned.
- c. Do not allow the motor to tip down at the pulley end. Tighten the mounting screws.

5.21 REPLACING THE SHUTTLE BELT

When the Shuttle Belt has become worn, cracked, broken or damaged, it must be replaced by proceeding as follows:

- a. Remove the screws and washers holding the Cam Cover. Wipe off any metal chips left by the star washers. Remove the cover and its gasket.
- b. Loosen the screw behind the MPU arm and turn the MPU arm away from the flywheel as far as the support plate allows (**Figure 94**).

CAUTION

Do not disturb the MPU clamping screw.

- c. Remove the shaft retainer screw from each end of the flywheel shaft.
- d. Lift the rear end of the flywheel shaft and slip the shuttle belt off the flywheel rim, past the rear end of the shaft.
- e. Remove the belt from the shuttle motor pulley. (Make sure the pulley is not loose on the shaft.)
- f. Install the new belt onto the shuttle motor pulley and over the flywheel rim, being sure the belt teeth are aligned with the grooves in the pulley and the flywheel.
- g. Position the rear end of the flywheel shaft against the roll-pin stop in the main casting (**Figure 96**). Verify that the flats on the flywheel axle draft are up at 45 degrees and that the axis of the cams high lobes are vertical. Insert the shaft screws into each end of the flywheel shaft and tighten them into the casting.
- h. Rotate the flywheel a few turns to align the belt with the shuttle motor pulley.
- i. Check the belt tension per subsection 5.20. Adjust if necessary.
- j. Reposition the MPU arm and adjust the MPU per subsection 5.25.

5.22 REPLACING THE SHUTTLE MOTOR AND THE SHUTTLE MOTOR PULLEY

To remove the shuttle motor or to change the Shuttle Motor Pulley, proceed as follows:

NOTE

When changing the pulley to adapt the printer to operate on a different line frequency refer to information in subsection 5.44 for correct line frequency part numbers.

- a. Disconnect the AC power from the printer.
- b. Remove the Printer Cover per subsection 5.2.
- c. Remove the two screws and star washer retaining the Cam Cover. Wipe off any metal chips left by the star washers, then remove the cover and its gasket.
- d. Loosen the four screws that hold the Shuttle Motor to its mount, permitting the motor to lower to the bottom of the screw slots (**Figure 97**).
- e. Slip the shuttle belt off the Shuttle Motor Pulley.
- f. Remove the cover from the terminal strip located on the Right Side Plate. Tag the motor leads with numbers to match the terminal numbers. Remove the terminals.
- g. Disconnect the motor ground lead from its terminal.
- h. Remove the four screws and washers from the motor mount while supporting the weight of the drive motor.
- i. Remove the motor by moving it rearward until it clears the paper feed motor. Then lift it upward and out of the printer.

To replace the Shuttle Motor, reverse the removal procedures. When connecting the motor wires, be sure that the labeled leads are connected to the same numbered terminals of the terminal strip and reconnect the motor ground lead to its terminal.

To remove and replace the Shuttle Motor Pulley, continue as follows:

- a. Remove the three screws and star washers that hold the pulley assembly to the face of the Shuttle Motor Pulley Adapter (attached to the motor shaft).
- b. Remove the pulley from the end of the motor shaft.
- c. Slip the new pulley onto the motor shaft.
- d. Align the screw holes in the pulley with those in the adapter. Replace and tighten the three screws and star washers removed in Step a above.

Following replacement of the Shuttle Motor or the Shuttle Motor Pulley, adjust the shuttle belt tension per subsection 5.20.

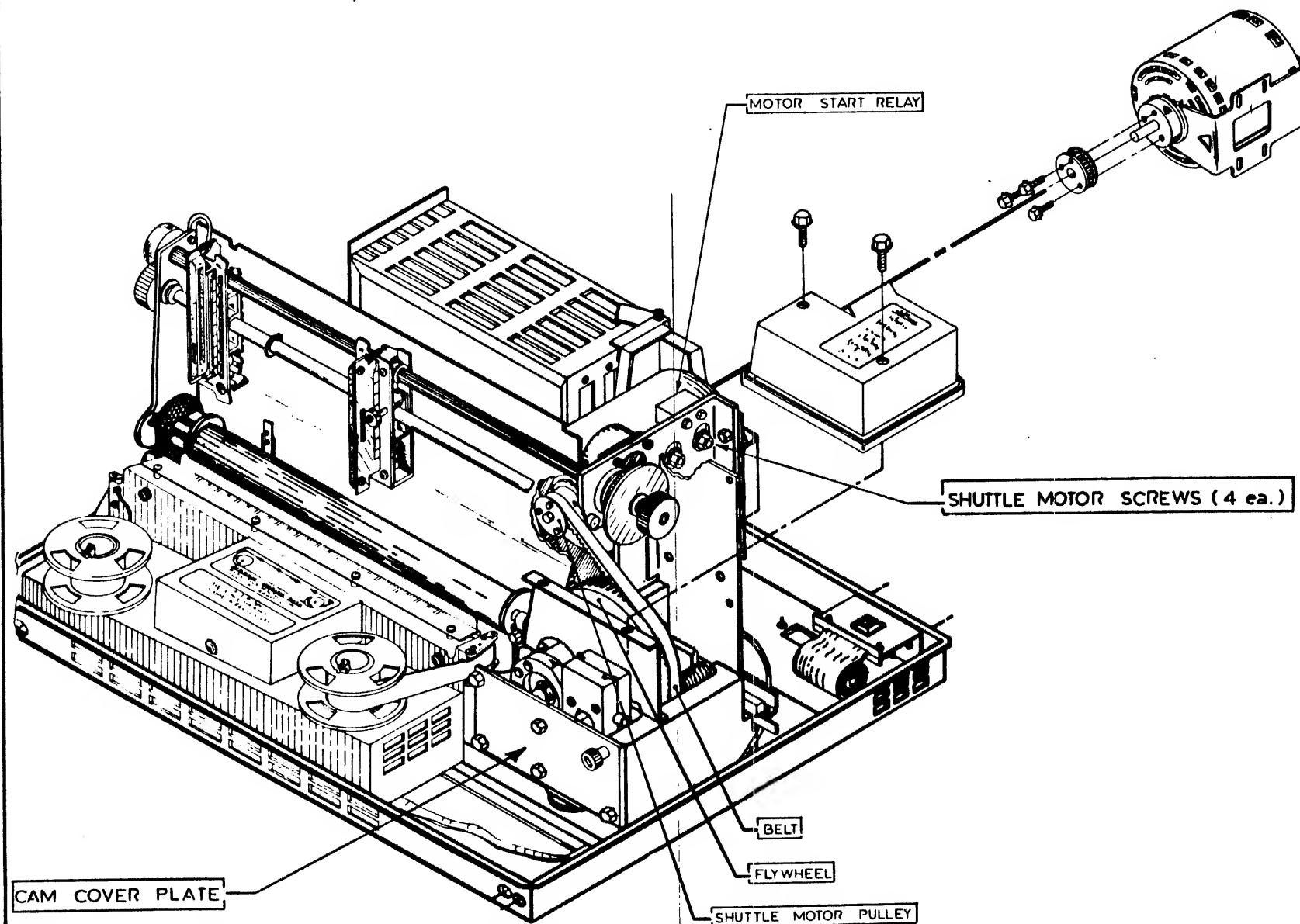


Figure 97 Replacing the Shuttle Motor and Pulley

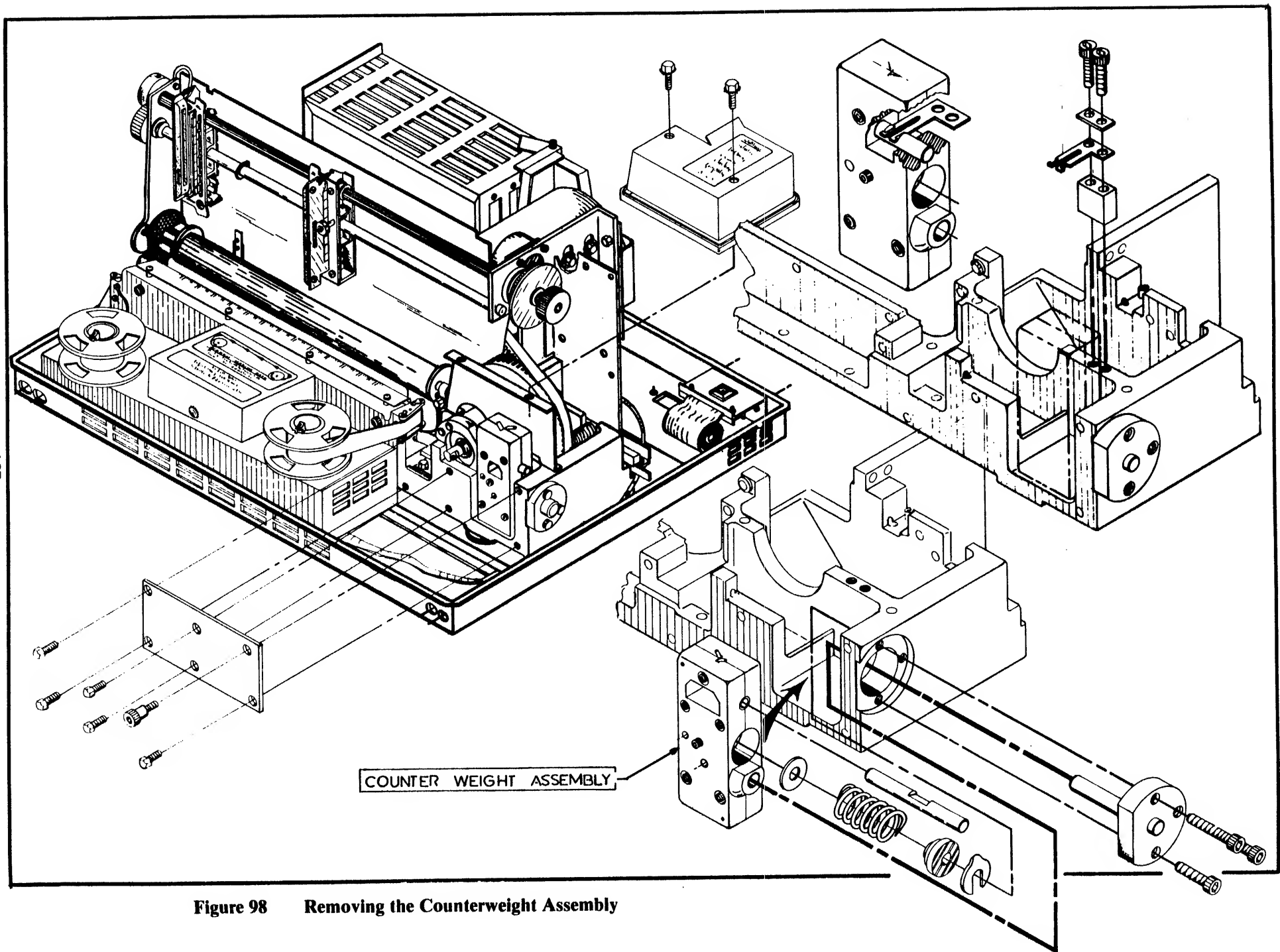


Figure 98 **Removing the Counterweight Assembly**

5.23 REPLACING THE COUNTERWEIGHT ASSEMBLY

The Counterweight Assembly may need to be removed in order to replace a worn shaft, bushing, or spring, or to remove and replace the Flywheel Assembly. To remove and replace the Counterweight Assembly, (Figure 98) perform the following steps:

- a. Remove the screws and star washers holding the cam cover. Wipe off any metal chips left by the star washers, then remove the cover and its gasket.
- b. Remove the screws and star washers holding the cam cover plate, then remove the plate with its gasket.
- c. Remove the two screws and star washers from the counterweight leaf spring and the leaf spring spacer; then remove the spring by rotating it free of its engagement in the cut in the upper counterbalance.
- d. Remove the three screws and star washers from the lower shaft assembly; then pull the Lower Counter Shaft Assembly out of the counterweight
- e. Lift the counterweight upward away from the cam. The counterweight, the spring spacer, shims, washers and upper counterbalance will come free as all loose pieces.

NOTE

No assemblies or individual parts of this unit are under heavy spring tension so there is no possible hazard of injury to personnel or of parts being lost by flying away.

To replace the Counterweight Assembly, reverse the removal procedures. When reinstalling the assembly removed in the preceding steps, use the same shims. However, if a different Counterweight Assembly is installed, it may be necessary to perform the shuttle spring force procedures outline in subsection 5.19.

5.24 REMOVING AND REPLACING THE FLYWHEEL ASSEMBLY

The Flywheel Assembly may need to be replaced because of worn bearings, galled or worn cam, or a damaged timing disk. To remove the Flywheel Assembly proceed as follows:

- a. Remove the Counterweight Assembly per subsection 5.23.
- b. Loosen the screw behind the MPU arm and turn the MPU arm away from the flywheel as far as the support plate allows (Figure 96).

CAUTION

Do not disturb the MPU clamp screw.

- c. Remove the screws holding each end of the flywheel shaft.
- d. Lift the Flywheel Assembly and slip the shuttle belt off the flywheel rim, past the rear flywheel shaft. Remove the Flywheel Assembly.

To replace the Flywheel Assembly, perform the following steps:

- a. Lift the new flywheel into position, slipping the shuttle belt over the rear shaft and onto the flywheel rim. Be sure that the belt teeth engage the grooves in the pulley.
- b. Position the rear of the flywheel shaft against the roll pin stop in the main casting. Verify that the flats on the axle shaft are up at 45 degrees and the axis of the cams high lobes are vertical. Insert the shaft screws into each end of the flywheel shaft and tighten them into the casting.
- c. Rotate the flywheel a few turns to align the Shuttle Belt with the Shuttle Motor Pulley.
- d. Replace the Counterweight Assembly, per subsection 5.23 but do not replace the cam cover, cam cover plate or their gaskets at this time.
- e. Position the MPU arm in its normal operating position and hand tighten the screw behind the MPU arm. Adjust the MPU per subsection 5.25.

NOTE

DO NOT rotate the flywheel prior to MPU gap adjustment.
The MPU and timing disk may be destroyed if the rotating
disk contacts the MPU.

- f. Check the Shuttle Belt tension per subsection 5.20. Adjust the belt tension, if necessary.
- g. Check the cam oiling wick to be sure it is in contact with the cam and properly lubricated per Section 3, subsection 3.9.
- h. Replace the gaskets, plate, and cam cover.

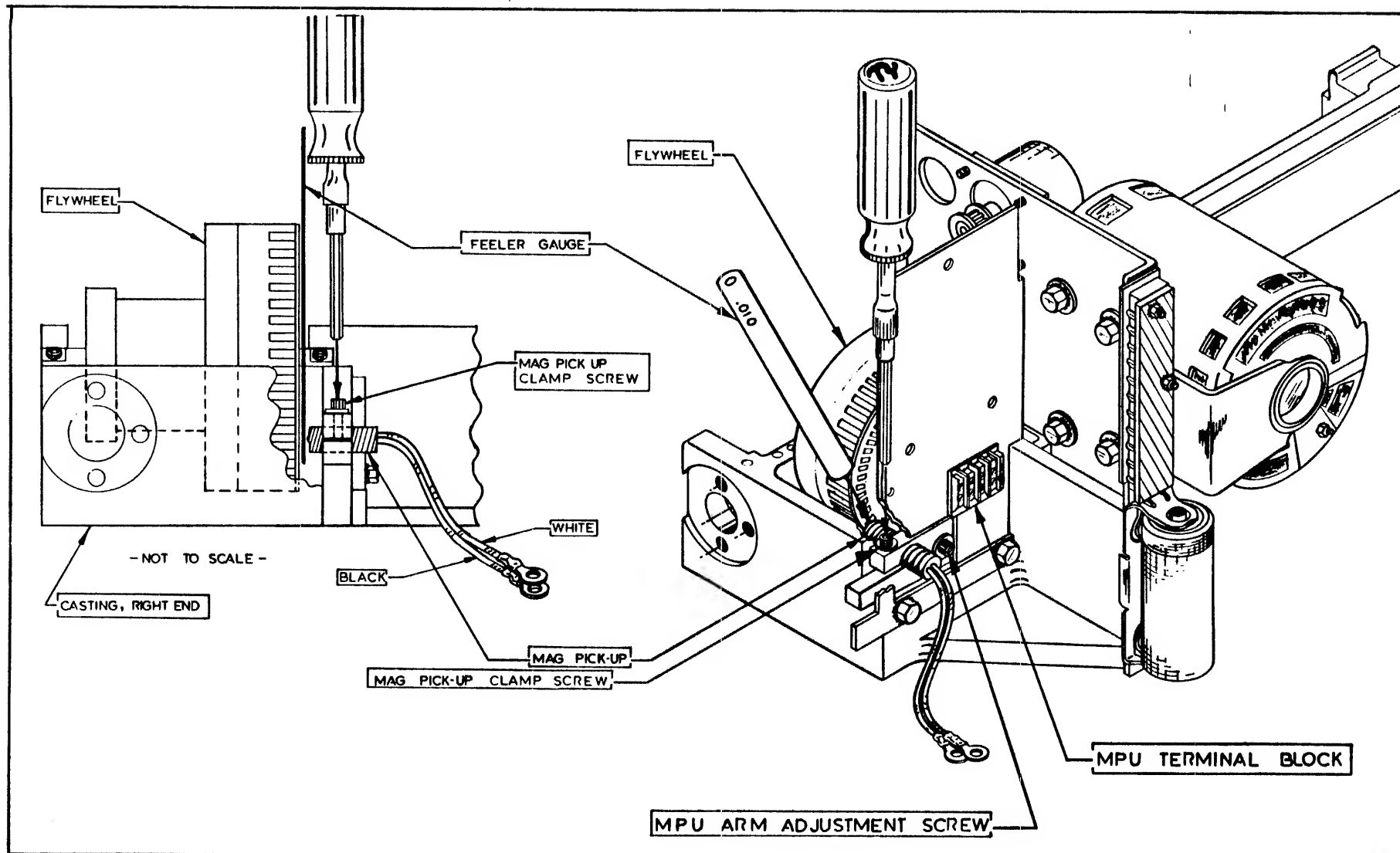


Figure 99 **Adjusting the Magnetic Pickup Gap**

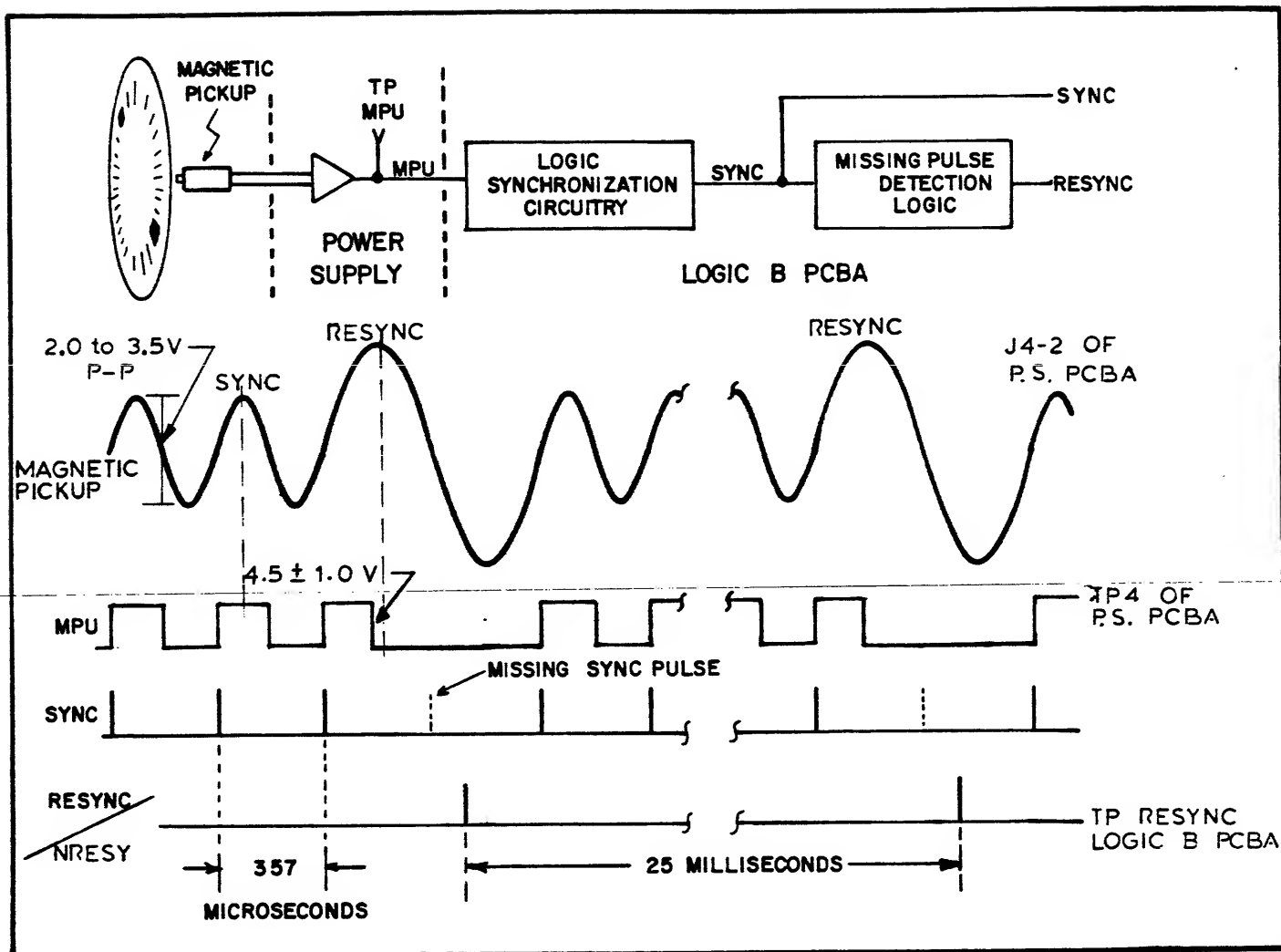


Figure 100 Operation of SYNC and RESYNC

5.25 ADJUSTING THE MAGNETIC PICKUP ASSEMBLY

There are two procedures required in adjusting the Magnetic Pickup (MPU). The first procedure establishes the gap between the MPU and the timing disk. The second sets timing (phasing) so that dots printed in adjacent dot rows (during alternate shuttle movements) are vertically aligned.

To adjust the gap between the MPU and the timing disk, proceed as follows:

- a. Loosen the clamp screw on the upper surface of the MPU arm so the MPU may be rotated in its threads.
- b. Insert a 0.010 feeler gauge between the pickup and timing disk (**Figure 99**). Adjust the gap between the MPU and the timing disk to 0.010 inches by rotating the MPU arm. Tighten the clamp screw.

CAUTION

After adjusting, be certain that the MPU is locked in place before the flywheel is turned. The MPU and timing disk may be destroyed if the rotating disk contacts the magnetic pickup.

- c. Connect an oscilloscope across Pin 2 of the adjacent terminal strip and ground. Verify that the output of the MPU is between 2.0 volts and 3.5 volts P-P (**Figure 100**).

To adjust hammer phasing, first set the MPU gap and then perform the following steps:

- a. Loosen the screw behind the MPU arm only slightly (**Figure 97**) so the arm does not swing freely but can be manually pivoted through a vertical arc with some pressure applied.
- b. Load the printer with 14 7/8 inch wide, single part paper. Connect the Exerciser to the interface connector. Set the Exerciser switches as follows:
 - Line Length = 132
 - Character = H
 - Special = none
 - Function = LF
 - Polarity = LO if jumper W7 on Logic A PCBA is installed; HI if that jumper is not installed.

NOTE

If no Exerciser is available, the self test pattern may be run at the control panel. Alternately, a printer controller may be used.

- c. Press the ON LINE pushbutton and observe the relative horizontal position of dots in alternate rows. Rotate the MPU arm until the dots in succeeding rows are aligned within .005 inch (Figure 101).

NOTE

Use any long shafter tool as a pry bar for making the adjustment. Insert the pry bar in the bracket straddling the end of the MPU arm.

- d. When phasing is correct, tighten the arm holding the screw at the rear of the MPU arm. Recheck the dot alignment after tightening, since tightening can sometimes cause a minor displacement of the MPU arm.

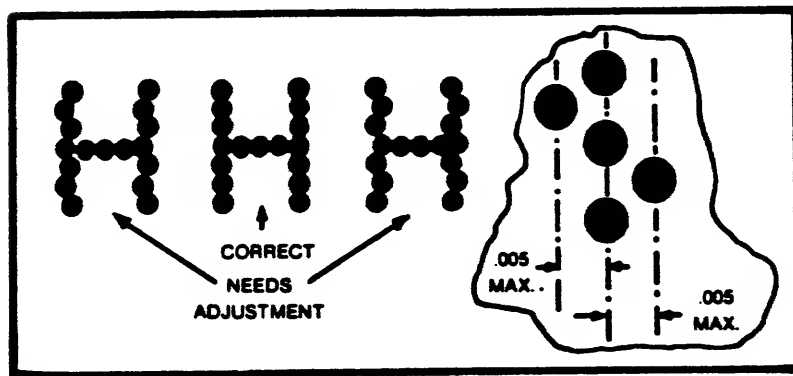


Figure 101 **Effect of Magnetic Pickup Phasing Adjustment**

5.26 REPLACING THE MAGNETIC PICKUP ASSEMBLY

To replace the failed Magnetic Pickup (MPU), proceed as follows:

- a. Loosen the clamp screw on the upper surface of the MPU arm so that the MPU may be rotated in its threads.
- b. Disconnect the MPU leads from terminals 1 and 2 on the adjacent terminal strip (Figure 99).
- c. Unscrew the MPU from the hole in the MPU arm then remove it from the printer.
- d. Screw the new MPU into the hole until its face is approximately 1/2 turn from the surface of the timing disk.
- e. Connect the MPU's white lead to terminal 1 and the black lead to terminal 2 of the terminal strip on the right side plate.
- f. Adjust the MPU per subsection 5.25.

5.27 THE PAPER FEED MECHANISM

The Paper Feed Mechanism includes the paper feed motor and pulley, the paper feed belt, the spline shaft assembly and its pulley, the vertical forms adjustment controls, two tractors and the support shaft (Figure 102).

5.28 ADJUSTING THE PAPER FEED BELT

The Paper Feed Belt must be tensioned correctly between the paper feed motor pulley and the spline shaft pulley. The belt should have a 1/16 inch deflection midway between the pulleys when pressed at that point (Figure 53). To adjust belt tension:

- a. Loosen the four screws holding the paper feed motor to its mount.
- b. Adjust the motor position to either loosen or tighten the belt for the 1/16 inch deflection. Make sure the belt is centered on the small pulley; then tighten the motor mounting screws.

NOTE

Do not use a pry bar technique between the paper feed motor base plate and spline shaft bearing race. The stress required to tension the belt could easily damage the spline shaft bearing or the shaft itself.

5.29 REPLACING THE PAPER FEED BELT

To replace the Paper Feed Belt, proceed as follows:

- a. Loosen the set screw in the left bushing at the left-hand end of the spline shaft. Slide the spline shaft and the belt to the right, until the spline shaft bearing is free of the left side plate (**Figure 104**).

NOTE

If the tension of the belt is so great that the shaft cannot be moved far enough to disengage the bearing from its recess in the left side plate, loosen the motor securing screws and slacken the belt tension.

- b. Remove the Paper Feed Belt from the Paper Feed Motor Pulley, and the Spline Shaft Pulley; then slip the belt over the end of the spline shaft and forms adjustment disc.
- c. Press the spline shaft against the left side plate but do not seat it. Route the new belt onto the spline shaft pulley and the paper feed motor pulley.
- d. Slide the spline shaft and its bearing back to the left. Seat them in the left side plate. Allow an axial clearance between the bushing and the left side plate of between 0.005 inch and 0.0010 inch. Replace the bushing on the shaft.
- e. Align the paper feed motor pulley with the spline shaft pulley and center the paper feed belt on the motor pulley.
- f. Tighten the set screw in the bushing making sure the set screw is perpendicular to the flat on the spline shaft.
- g. Check the tension of the paper feed belt and adjust, if necessary, per subsection 5.28.
- h. Make sure that the paper tractors have remained parallel on the shafts, and adjust, if necessary.

5.30 REPLACING THE PAPER FEED MOTOR

To remove the Paper Feed Motor, remove the printer cover per subsection 5.2 (**Figure 102**); then perform the following steps:

- a. Disconnect the PF MOTOR cable from the Power Supply PCBA.
- b. Cut the cable ties holding the motor cable.
- c. Remove the four screws and star washers holding the paper feed motor. Remove the motor from its mount.
- d. Remove the paper feed motor and its cable.

Reverse the above instructions to install the replacement motor. Perform the belt adjustment per subsection 5.28. Reinstall the printer cover per subsection 5.2.

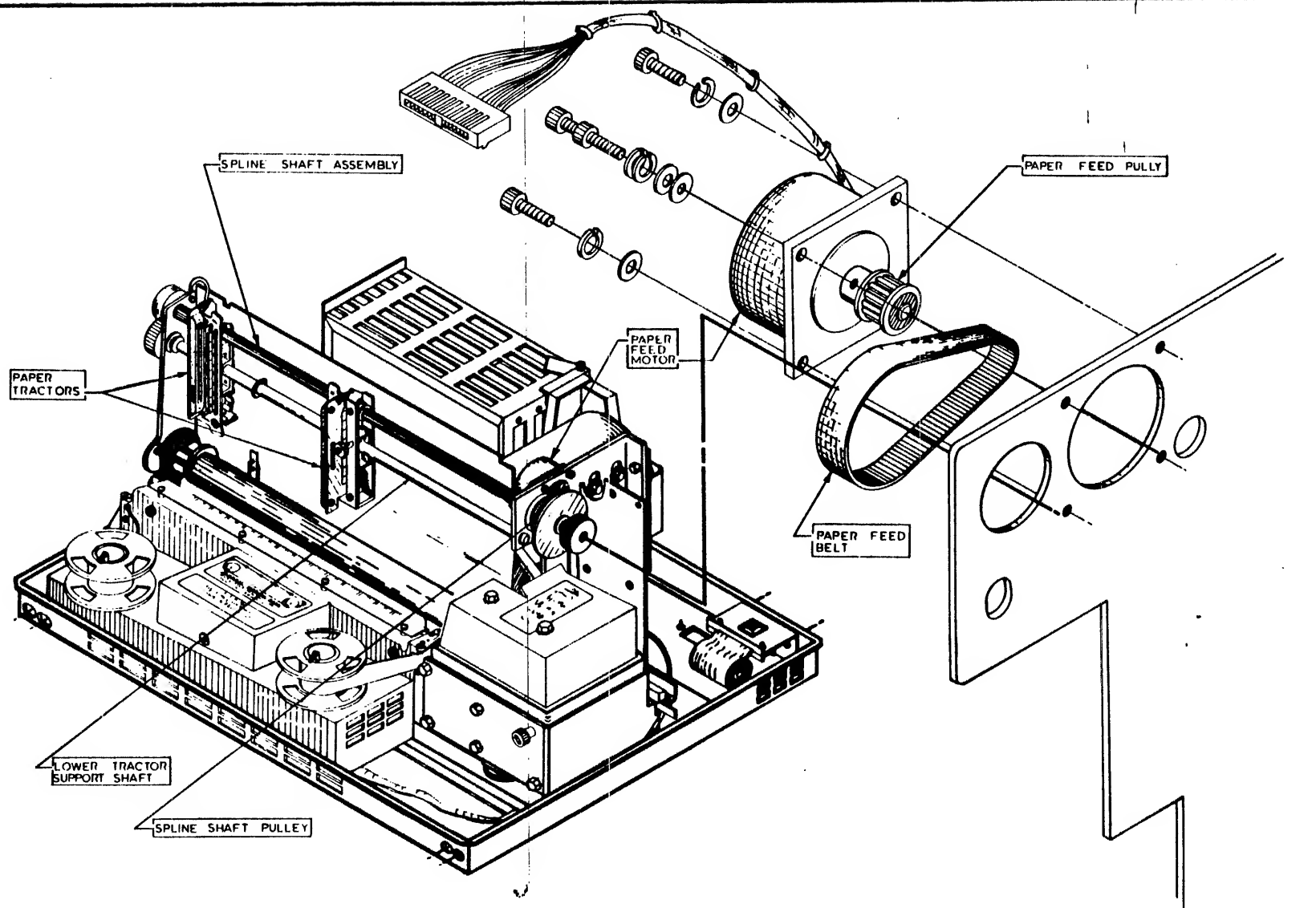


Figure 102 Replacing the Paper Feed Motor

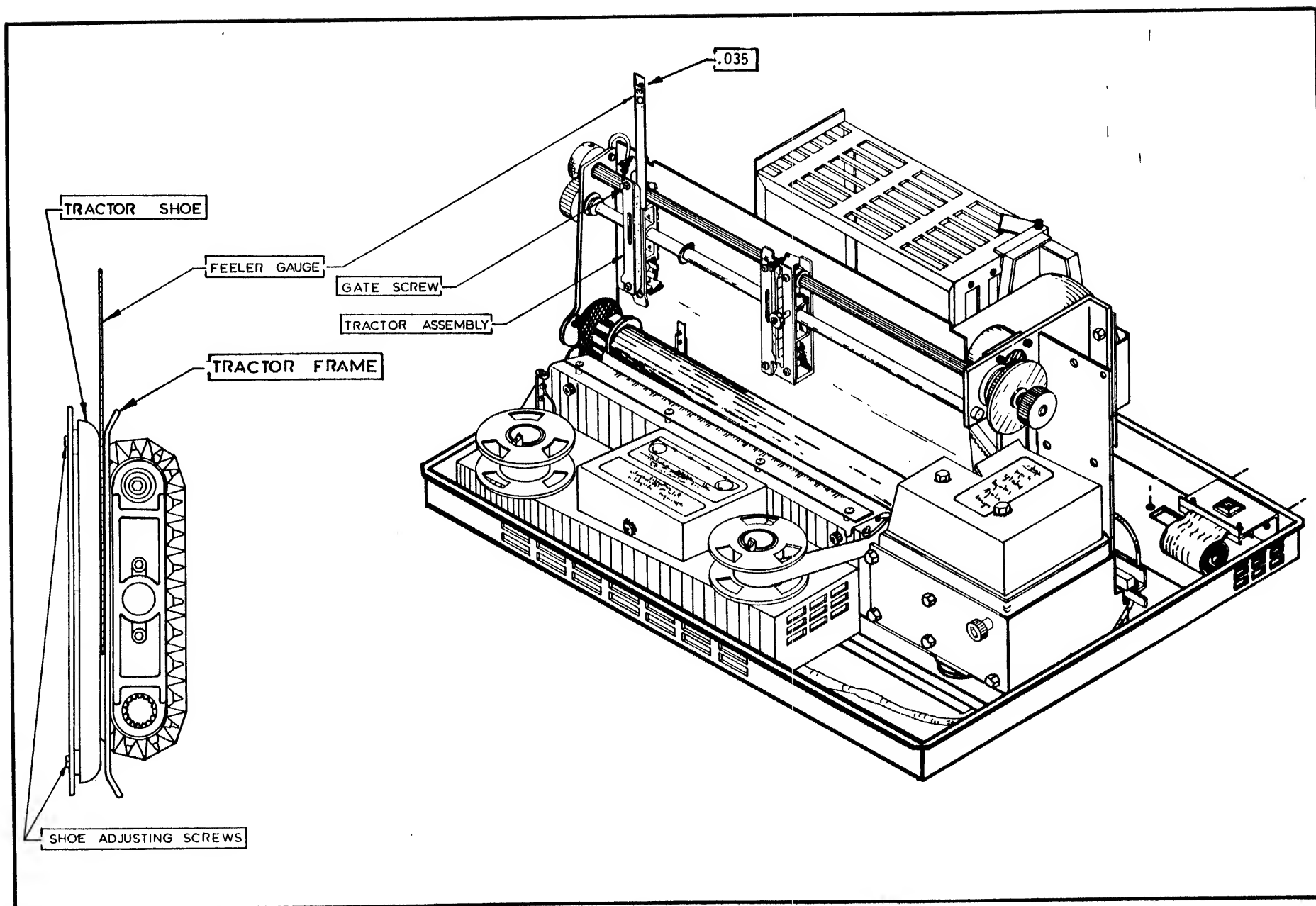


Figure 103 Adjusting the Tractor Shoe

5.31 ADJUSTING THE TRACTOR SHOE

If the gap between the tractor shoe gate and frame is not correctly set, paper may bind in the tractor, especially during high speed slew operations (**Figure 103**). Check the gap and adjust if necessary, performing the following steps:

- a. Remove the paper from the printer.
- b. Insert a 0.035 inch feeler gauge between the tractor shoe and frame, being careful not to lift the shoe with the gauge.
- c. Adjust the screw at each end of the tractor shoe (**Figure 103**), so that the gap is 0.035 inch + 0.005/ - 0.000 inch at both ends of the Tractor Shoe. Adjust the screws clockwise to increase the gap or counterclockwise to decrease the gap.

Tractor belt tension is adjusted at the factory using special equipment. This adjustment is not practical in the field. In general, if the tractor continues to bind after the shoe gap is checked and adjusted, the tractor should be replaced per subsection 5.32.

5.32 REPLACING THE PAPER TRACTOR

To remove and replace the tractor, perform the following:

- a. Remove the AC power from the printer.
- b. Remove the paper from the printer. Loosen both knurled tractor clamping nuts.
- c. Free the left-hand end of the support shaft in the following manner:
 1. Remove the axial locking screw, star washer, and flat washer from the knob center (**Figure 104**).
 2. Unscrew the support shaft until it is free from the tractor.
- d. Free the left-hand end of the spline shaft in the following manner:
 1. Loosen the set screw in the bushing on the left-hand end of the spline shaft and remove the bushing.

CAUTION

Do not allow filings to fall into the mechanism.

2. Slide the spline shaft and the paper feed belt to the right, until the left-hand end of the spline shaft permits removing the tractors.

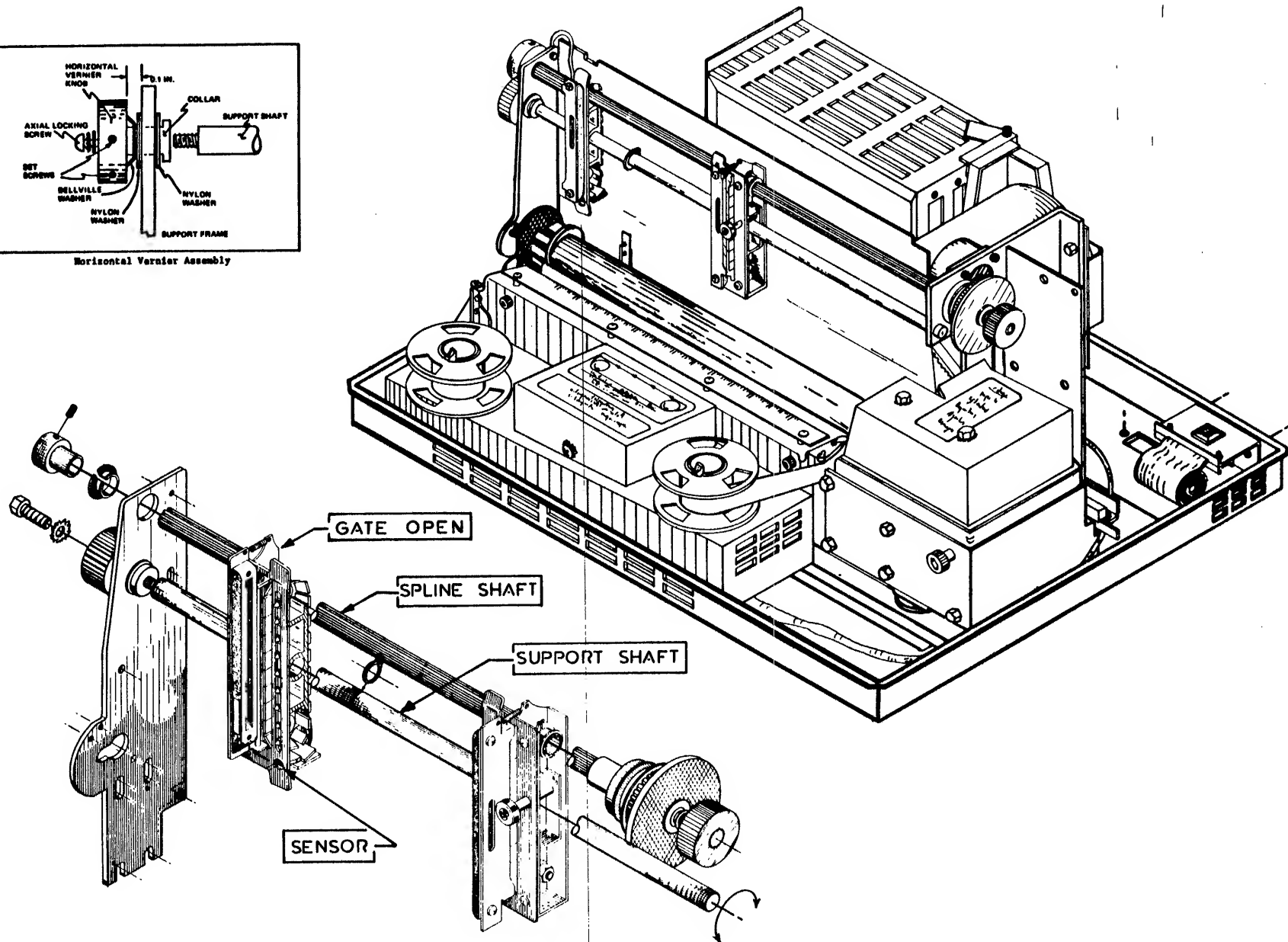
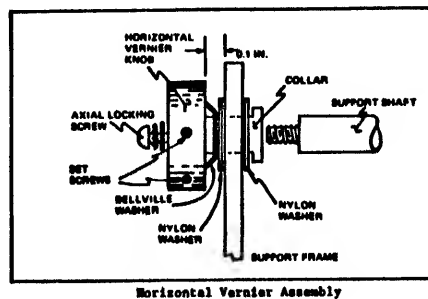


Figure 104 Replacing the Paper Tractor

NOTE

When removing the left-hand tractor proceed as follows:

- a. Remove the Paper Motion Sensor Assembly per subsection 5.35.
 - b. Cut the cable ties that secure the Paper Motion Sensor Cable Assembly to the tractor before removing the left-hand tractor out of the way.
 - c. Replace the cable ties after replacing the tractor.
-

- e. Slide the tractor to be replaced off the free end of both the support shaft and the spline shaft. Slide the new tractor onto the free end of each shaft. Remove and replace the support shaft keeper when changing the right tractor.

NOTE

Be sure to align the two tractors in coordination with each other on the spline shaft. A red painted sprocket pin is found on each tractor to assist in this alignment.

- f. Reassemble the Spline Shaft Assembly as follows:

1. Slip the paper feed motor belt on the motor pulley.
2. Slide the spline shaft back to the left into its seat and replace the bushing on the left-hand end of the spline shaft. Allow an axial clearance between the bushing and the support frame of 0.005 inch to 0.010 inch.
3. Align the paper feed motor pulley with the spline shaft pulley and center the paper feed belt on the motor pulley.

- g. Reassemble the support shaft and Horizontal Vernier Assembly as follows:

1. Slide the support shaft to the left to engage the threads in the boss of the Horizontal Vernier Assembly; then rotate the Horizontal Vernier Knob boss clockwise to thread the support shaft into the boss.
2. Install a star washer, then a flat washer, on the axial locking screw. Install and tighten the screw in the axis of the boss.

- h. Check the tension of the paper feed belt and adjust, if necessary, per subsection 5.28.

- i. Make sure the paper tractors are parallel on the shafts and adjust, if necessary.

5.33 REMOVING AND REPLACING THE PAPER IRONER

To remove and replace the Paper Ironer (**Figure 105**), proceed as follows:

- a. Mount the Ribbon Drive Assembly in the service position per subsection 5.7.
- b. Loosen the comb retaining screws. Unplug the four coil wire connectors and lift them to expose four Paper Ironer retaining screws (**Figure 105**).
- c. Loosen the Paper Ironer retaining screws.
- d. Rotate the hammer bank into the service position per subsection 5.15.
- e. Remove the old Paper Ironer.
- f. Clean any paper chaff from in and around the Paper Ironer mounting area.
- g. Replace the Paper Ironer.
- h. Tighten the Paper Ironer retaining screws.
- i. Reassemble the printer reversing the instructions in steps d, b, and a above.

5.34 ADJUSTING THE PAPER MOTION SENSOR ASSEMBLY

The Paper Motion Sensor Assembly device comprises an infra-red LED, a phototransistor and is attached to the left-hand tractor. Light emitted by the LED is reflected into the phototransistor by the paper passing through the left-hand paper tractor. If the sensor is incorrectly adjusted or has low output, the CHECK light may turn on each time paper is slewed.

To check the position of the sensor proceed as follows:

- a. Remove the paper from the printer and open the left-hand tractor gate to expose the sensor in its alignment bracket. Both apertures in the sensor must be completely visible through the opening at the bottom of the tractor frame (**Figures 104 and 106**).
- b. If both apertures are not completely visible adjust the sensor positions as follows:
 1. Loosen the support shaft per subsection 5.32 Step c 1 and 2.
 2. Remove the support bracket securing nut and star washer.
 3. Loosen the two retaining screws and realign the sensor. Tighten the retaining screws.
 4. Reinstall the support bracket, its nut and washer.

To check the output of the sensor:

- a. Remove the paper from the printer.
- b. Measure the voltage at capacitor C1 on the Power Supply PCBA. The voltage should be near zero.
- c. Position a piece of white paper in front of the sensor apertures. The voltage at capacitor C1 should be at least 150 millivolts (sinusoidal).

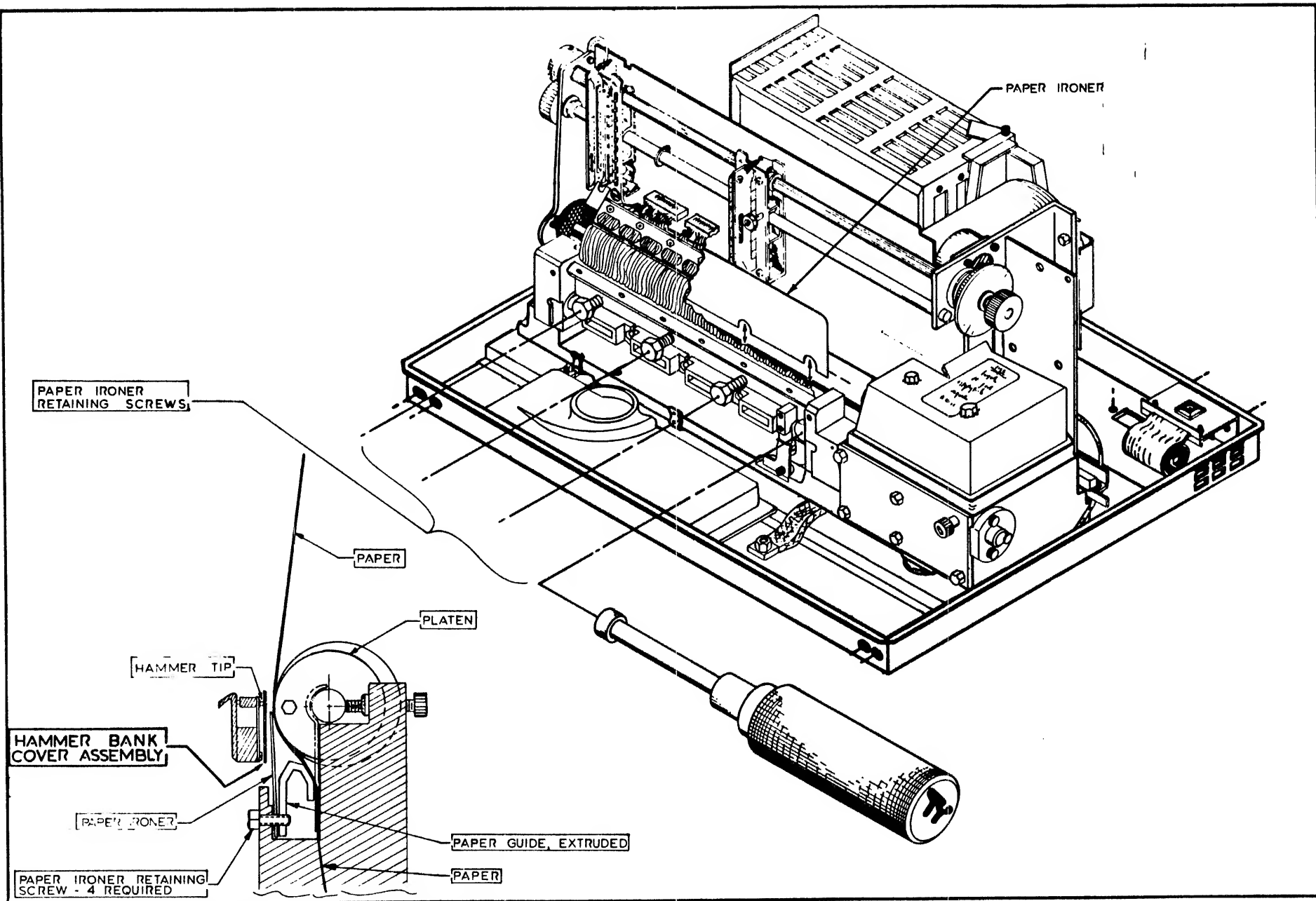


Figure 105 Paper Ironer Removal/Replacement

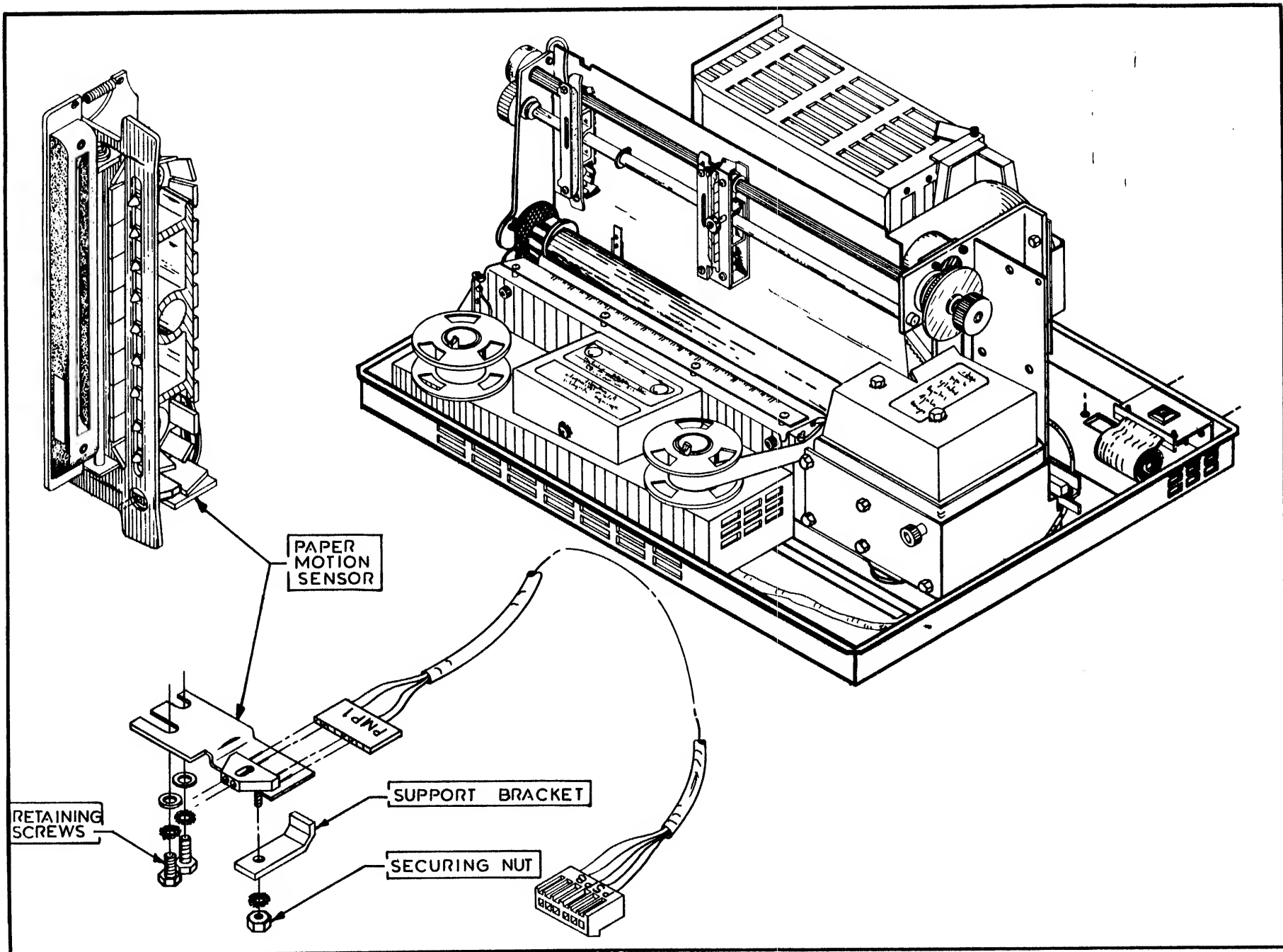


Figure 106 Removing and Replacing the Paper Motion Sensor

To check overall sensor circuit function proceed as follows:

- a. Verify that the factory installed sensor jumper (W6 on the Logic B PCBA) is in place.
- b. Load paper and run a number of Top of Form operations.
- c. Set the exerciser to the self test mode to run a few pages of a pattern.

If the CHECK indicator does not turn on during any of these tests sensor operation is assured.

5.35 REMOVING AND REPLACING THE PAPER MOTION SENSOR ASSEMBLY

If the Paper Motion Sensor Assembly has failed the output and functional tests of subsection 5.34, it must be replaced.

To remove the Paper Motion Sensor Assembly device, proceed as follows:

- a. Turn off the power and remove the paper from the printer.
- b. Remove the screw and washers securing the support shaft and unscrew the support shaft itself (Figure 104).
- c. Remove the nut and star washer holding the plastic connector retainer to the left-hand tractor, and remove the retainer.
- d. Unplug the connector from the sensor.
- e. Loosen the two screws that hold the sensor assembly alignment bracket to the tractor, and then remove the bracket and sensor. (If the left-hand tractor is to be replaced, remove and retain the two screws.)
- f. To replace the Paper Motion Sensor Assembly reverse these removal procedures and adjust per subsection 5.34.

5.36 ADJUSTING THE PAPER-OUT SWITCH

The paper out switch causes a CHECK condition to occur if either;

- a. The Forms Thickness Adjustment lever is in the Load position, or
- b. No paper is sensed at the paper switch.

The switch is actuated by the platen pressing against the nylon button behind the platen or by paper pressing against the switch actuator below the platen.

To adjust the switch, perform the following steps (with the printer power on and with paper in the printer) Figure 107).

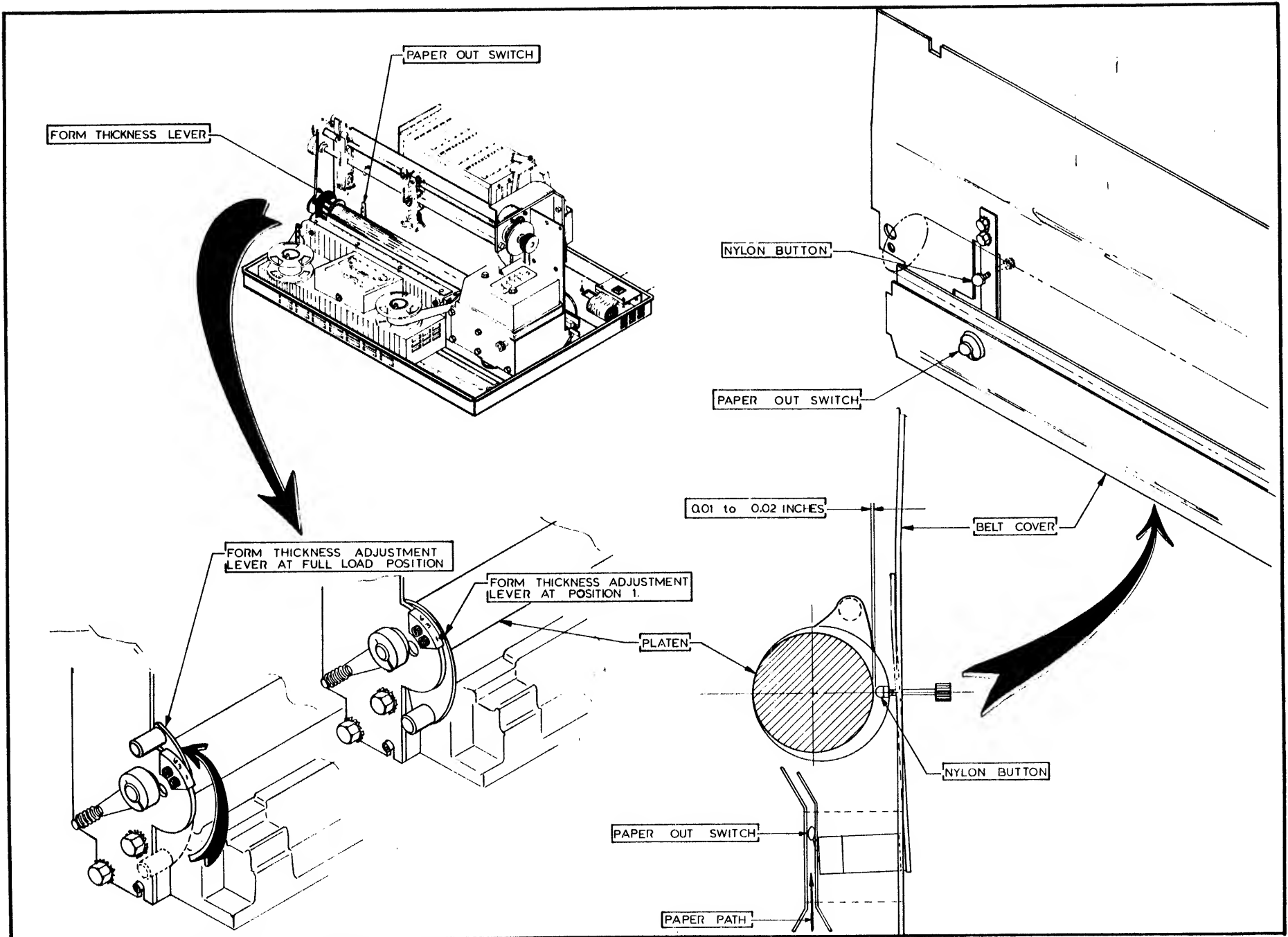


Figure 107 Adjusting the Paper-Out Switch

- a. Set the Forms Thickness Adjustment lever to position 1.
- b. Rotate the nylon button shaft so that its tip is between 0.010 and 0.020 inch from the platen surface.
- c. Set the Forms Thickness Adjustment lever so that the pointer is between 1/4 inch and 1/2 inch from position 6, toward the Load position.
- d. Rotate the nylon button shaft clockwise until the CHECK indicator turns off (if it is on); then turn it counterclockwise until the CHECK indicator turns on.
- e. Check operation of the paper out switch by demonstrating that paper motion stops when:
 1. The Forms Thickness Adjustment lever is in the Load position.
 2. Paper runs out at the platen while the lever is in any operating positions.

NOTE

If the paper out delay is functional (NO wire between F1 and F2 on the Logic B PCBA), paper motion will not cease immediately but will continue for 12 lines after CHECK is detected.

5.37 REPLACING THE PAPER OUT SWITCH

To replace the paper out switch, proceed as follows: **(Figure 108)**

- a. Turn off the power and remove the paper from the printer.
- b. Remove the two screws that hold the rear of the Power Supply Assembly to the printer base, Then slide the Power Supply Assembly as far as possible toward the rear of the printer.
- c. Disconnect cable connector PSP5 from the mating connector on the Power Supply PCBA and cut all the cable ties holding the cable to the printer.
- d. At the front of the Belt Cover Assembly, remove the two socket-head screws that hold the switch assembly to the belt cover.
- e. Rotate the lower end of the switch assembly through the hole in the belt cover and remove the switch assembly and its cable through the front of the belt cover.
- f. Install the new paper out switch assembly, reversing the removal procedures. Be sure to route the cable correctly and replace the cable ties.
- g. Adjust the paper out switch per subsection 5.36.

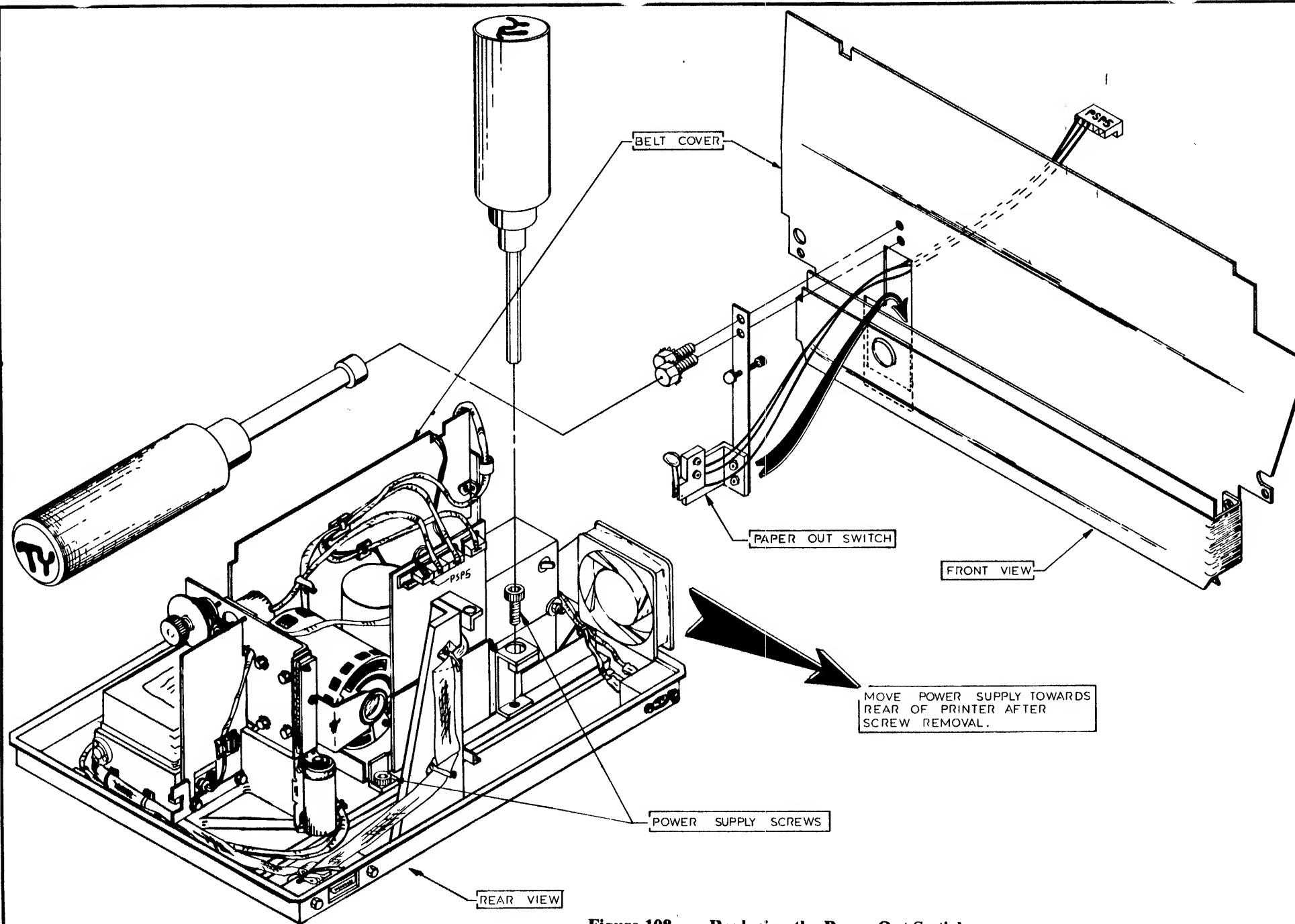


Figure 108 Replacing the Paper-Out Switch

5.38 THE POWER SUPPLY ASSEMBLY

The Power Supply circuits include components contained directly on the chassis of the Power Supply Assembly (Figure 109), components contained on the Power Supply PCBA, the cooling fan, and the AC power switch.

The Power Supply PCBA may be removed from the power supply chassis with the printer cover and the chassis in place. Other maintenance procedures (except fuse replacement) require the removal of either the Printer Cover per subsection 5.2 or the Power Supply Assembly per subsection 5.42.

5.39 THE AC CIRCUIT BREAKER

The AC line is not fused in the printer. A circuit breaker is located in the transformer cover at the rear of the power supply assembly and is accessible when the card cage is swung open. A single circuit breaker is connected to the high side of the line voltages up to 120 VAC, while a double circuit breaker is connected to both sides of a line voltage of 220 VAC or more.

5.40 REPLACING THE DC SUPPLY FUSES

Fuses for the DC power supplies are held in clips on the lower part of the Power Supply PCBA and are accessible when the card cage has been swung open. Fuses are fast-blow types (Figure 109, top to bottom) as follows:

Fuse	Type	Supply Voltage
F1	8A3AG	+ 36V DC
F2	3A3AG	+ 5V DC
F3	3A3AG	- 36V DC

CAUTION

As a general safety precaution, be sure to turn off the AC power switch before handling the fuses on the Power Supply PCBA. Not all printers have bleeder resistors installed. If no bleeder resistor is installed a 1K ten watt resistor can be inserted across the path of the P.S. filter capacitors while working on the supply.

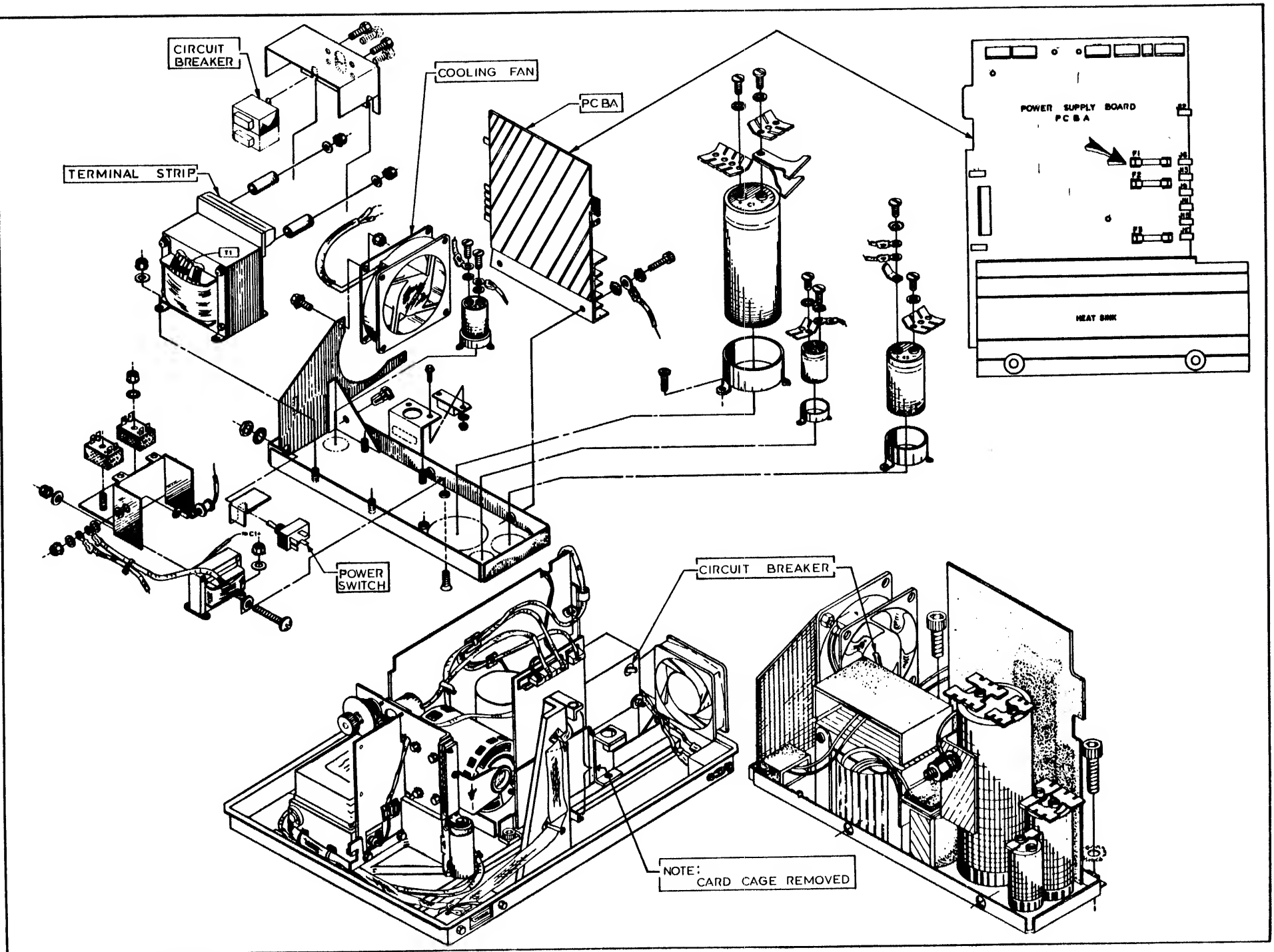


Figure 109 The Power Supply Assembly

5.41 REPLACING THE POWER SUPPLY PCBA

It is necessary to remove the Power Supply PCBA in order to replace components (other than fuses) on the PCBA (Figure 107).

To remove the PCBA, perform the following steps:

- a. Disconnect the AC Power Cord from the back of the printer and wait five minutes for the supply to discharge. Observe the caution in subsection 5.40.
- b. Disconnect all Molex type multi pin connectors from the PCBA and remove the ribbon cable connector (J2) from its left-hand edge.
- c. Disconnect the wires from all quick disconnect terminals on the PCBA. Note that wire identification matches the numerals identifying terminals on the PCBA.
- d. Remove the two screws at the lower edge of the heat sink and remove the Power Supply PCBA.

To replace the PCBA, reverse the removal procedures above.

CAUTION

In order to properly ground the PCBA, connect the left-hand quick disconnect terminal FIRST; then connect any other supply terminals. (For PCBA 104712, connect the THREE left-hand quick disconnects FIRST; then connect any other supply terminals).

Test the power supply voltages as follows:

- a. Disconnect the +36V DC wires from the larger chassis mounted +36V filter capacitor.
- b. Turn on AC power (nominal line voltage).
- c. With ambient temperature near +25 C, paper installed in the printer, the Exerciser connected, and the platen set to turn off the CHECK indicator, attach a digital voltmeter common lead to VREF 1V on the Power Supply PCBA.
 1. At the Logic B PCBA measure:
 - +5V DC \pm 0.25V DC (T.P. +5v)
 - -12V DC \pm 1.2V DC (T.P. -12v)
 2. At the Power Supply PCBA, measure:
 - +9.5V DC \pm 1.0V DC
 - +36V DC \pm 1.0V DC
 - -30V DC (-40V DC to -28.5V DC)

- d. If all voltages are within tolerances, turn off the AC power, reconnect the +36V DC wires to the large filter capacitor (removed in Step a.), and restore the printer to normal operation.

If the power supply voltages are out of tolerance, troubleshoot and repair the power supply circuits.

5.42 REMOVING AND REPLACING THE POWER SUPPLY ASSEMBLY

A failure in the power supply that is not caused by a component on the Power Supply PCBA will usually necessitate removal of the entire Power Supply Assembly. Remove the Power Supply Assembly as follows:

- a. Remove the printer cover per subsection 5.2 only if the power Supply Assembly contains PCBA 104712.
- b. Open the printed circuit card cage.
- c. Disconnect all cable connectors from the top and left edges of the Power Supply PCBA.
- d. Remove the screws and washers that hold the chassis of the Power Supply Assembly to the base pan.
- e. Disconnect the quick disconnect terminals at the AC line filter at the rear of the printer (mark the wire terminals to be sure they will not be reversed in reassembly).
- f. At the larger (+36V DC) chassis mounted filter capacitor, disconnect the wires that go to the Hammer Driver PCBA and the Hammer Bank Assembly.
- g. Loosen the nuts retaining the power transformer cover. Lift the cover to expose the wiring.
- h. Disconnect the wires at transformer terminals TB-1 and TB-7, going to the Ribbon Drive Assembly. Return the transformer cover to its closed position.
- i. Lift the rear of the Power Supply Assembly; pull it toward the door and slightly left, being careful not to hit the AC power switch against the cabinet. Remove the assembly through the door.
- j. Replace the Power Supply Assembly by reversing the removal procedure.

5.43 REPLACING THE REAR COOLING FAN

Remove and replace the rear cooling fan as follows:

- a. Turn off the AC Power to the printer.
- b. Remove the printer cover per subsection 5.2.
- c. Remove the nut and washer at the left-hand rear of the transformer cover and loosen the nut at the right-hand rear of the cover.

- d. Lift off the transformer cover to expose the terminal strip at the rear of the transformer.
- e. Loosen the screws at terminals TB1 and TB5 (numbered from the left-hand end) and remove the fan motor wires from the terminals (**Figure 109**).
- f. Remove the three screws that hold the fan to the side of the chassis, then remove the fan.
- g. Replace the fan with a new fan, reversing the removal procedures.

5.44 ADAPTING THE PRINTER FOR LINE FREQUENCY

If the printer is configured for either 50Hz or 60Hz line power but is to be operated in a site supplying power at the other frequency, the Shuttle Motor Pulley Assembly must be replaced per subsection 5.22 in order to maintain shuttle timing relationships.

Be sure that correct parts are installed, as follows:

FREQUENCY	PULLEY PART NUMBER
50 Hz	102737
60 Hz	102337

APPENDIX

6.1 PHASE FIRE

INTRODUCTION

This section describes the features of the P600 Phase Fire printer which are different from Non-Phase Fire printers discussed in earlier sections of this manual. The changed features are:

- Modification of the hammer spring shape to allow offset alignment.
- Addition of heat sinks to the coil assemblies and integrating the pole pin in the Shuttle Assembly.
- Each print hammer within a hammer pair (**Figure 110**) is offset a distance of 0.00417 inch toward the other so that the interval between those two hammer tips is one half dot column.
- Redesign of the Logic A PCBA for compatibility with both Phase Fire and Non-Phase Fire printers. Compatibility is easily maintained by adding jumper W-1 for Phase Fire, or leaving it out for non-Phase Fire.

As a result of these changes, the odd numbered and even numbered hammers (reading from left-to-right) are alternately fired. After one group of hammers is fired, the shuttle is shifted one half dot column within the dot row. This places the alternate group of hammers in the adjacent dot row because the sum of the half column hammer bank shift plus the half column interval within the hammer pair is one full column between dots. Then the alternate group is fired, and so on.

Because only half of the hammers are fired at any given time,

- The instantaneous current demand from the power supply is greatly reduced.
- Interaction between hammer coils is reduced.
- Hammer bank operating temperature is reduced.

In general, information presented in earlier sections remains valid for Phase Fire printers. Exceptions are noted above and in the following Adjustment, Removal, and Replacement subsection.

Print problems will occur with an incorrect combination of the Logic A PCBA and its W1 jumper, the Shuttle Assembly and the Logic A PCBA prom kits. **Figures 111 through 114** illustrate these problems and explain the circumstances which caused each one.

PHASE FIRE HAMMER COIL REPLACEMENT

To replace the Phase Fire hammer coil, refer to **Figure 110** and proceed as follows:

- a. Mount the Ribbon Drive Assembly in the service position per **Section 5**, subsection 5.7.
- b. Rotate the Hammer Bank Assembly into the service position per **Section 5**, subsection 5.15.

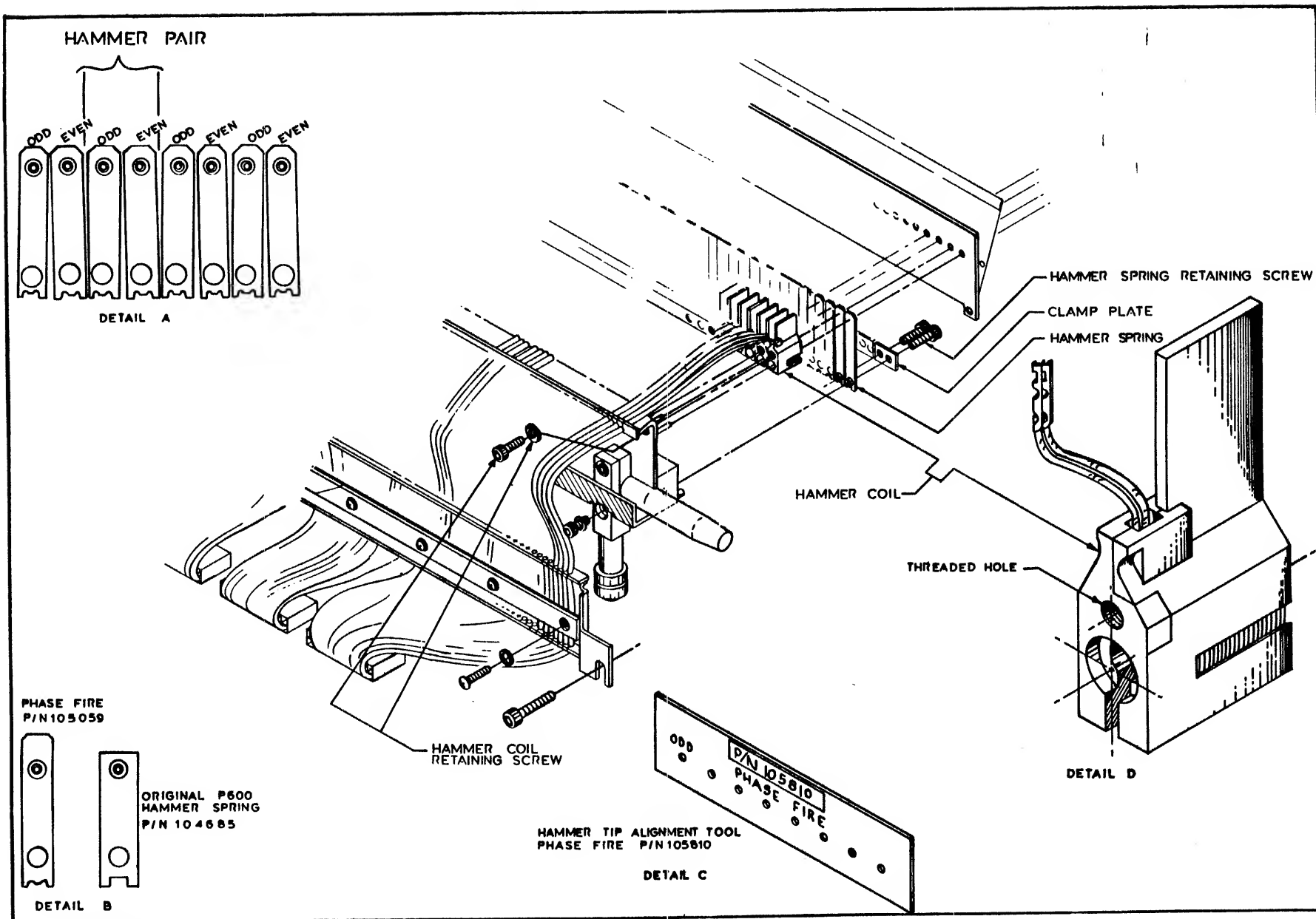


Figure 110 The Phase Fire Hammer Bank Assembly

- c. Remove the 3/32 inch Allen head screw that retains the hammer spring and clamp plate above the coil to be replaced.
- d. Loosen the other screw which shares the clamp plate.
- e. Slide the hammer spring forward and off the coil to be replaced. Then remove the coil retaining screw.
- f. Unplug the connector which contains the leads of the coil to be replaced.
- g. Gently lift the contact pin retainer for one of the leads and extract the lead. Do the same for the other lead.
- h. Carefully pull the coil leads free from the wire comb.
- i. Slip the old coil off the pole pin and replace it with the new coil.

CAUTION

**To prevent damage to the threaded screw hole in the coil,
DO NOT OVER-TORQUE the coil retaining screw.**

- j. Replace the coil retaining screw and torque it to 2 inch pounds. (Alternately, make it finger tight with an Allen wrench.)
- k. Thread the coil leads into the wire comb, matching the service loop of the other leads.
- l. Insert both contact pins into the connector, matching colors properly.
- m. Plug the connector into its receptacle, making sure that no male pins show on either side of the connector.
- n. Replace and realign the hammer spring per Section 5, subsection 5.16, steps d through f.

NOTE

Substitute short alignment tool 105810-001 or long alignment tool 105785-001 for those tools pictured in **Figure 89**. In subsection 5.16 step e, place the alignment tool on the hammer bank with its P/N on top, and its ODD hole over and odd numbered hammer spring tip (**Figure 110**, detail C).

- o. Restore the printer to operating condition as follows:
 - 1. Restore the Hammer Bank Assembly per **Section 5**, subsection 5.15.
 - 2. Replace the Ribbon Deck Assembly per **Section 5**, subsection 5.7.

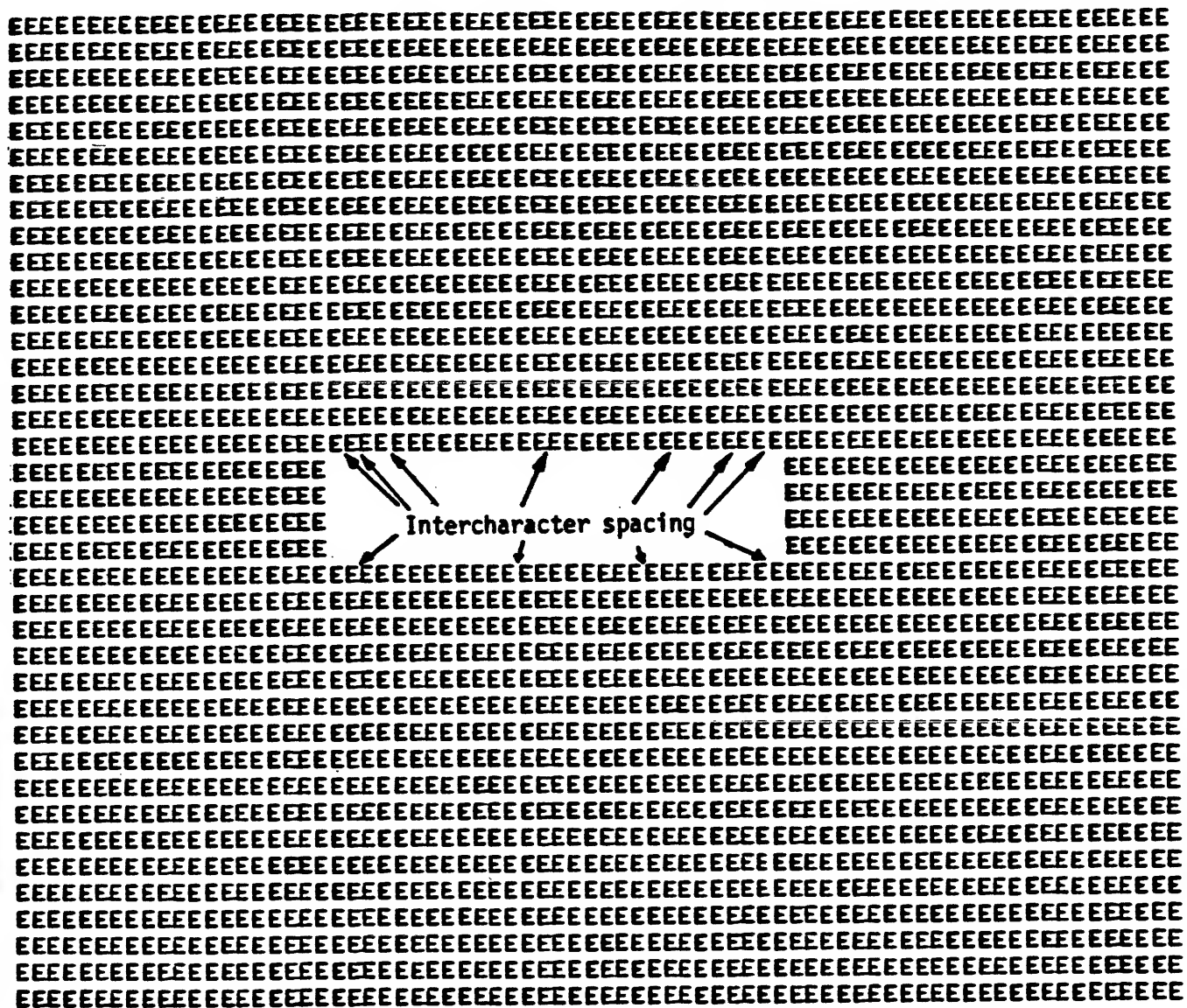


Figure 111 Phase Fire Print Problems

Intercharacter spacing will result when a Logic A4 (P/N 103831) is installed in a P600 with a Phase Fire Shuttle Assembly (P/N 105787-001) and either prom kit (P/N 104539-003 or 104539-008).

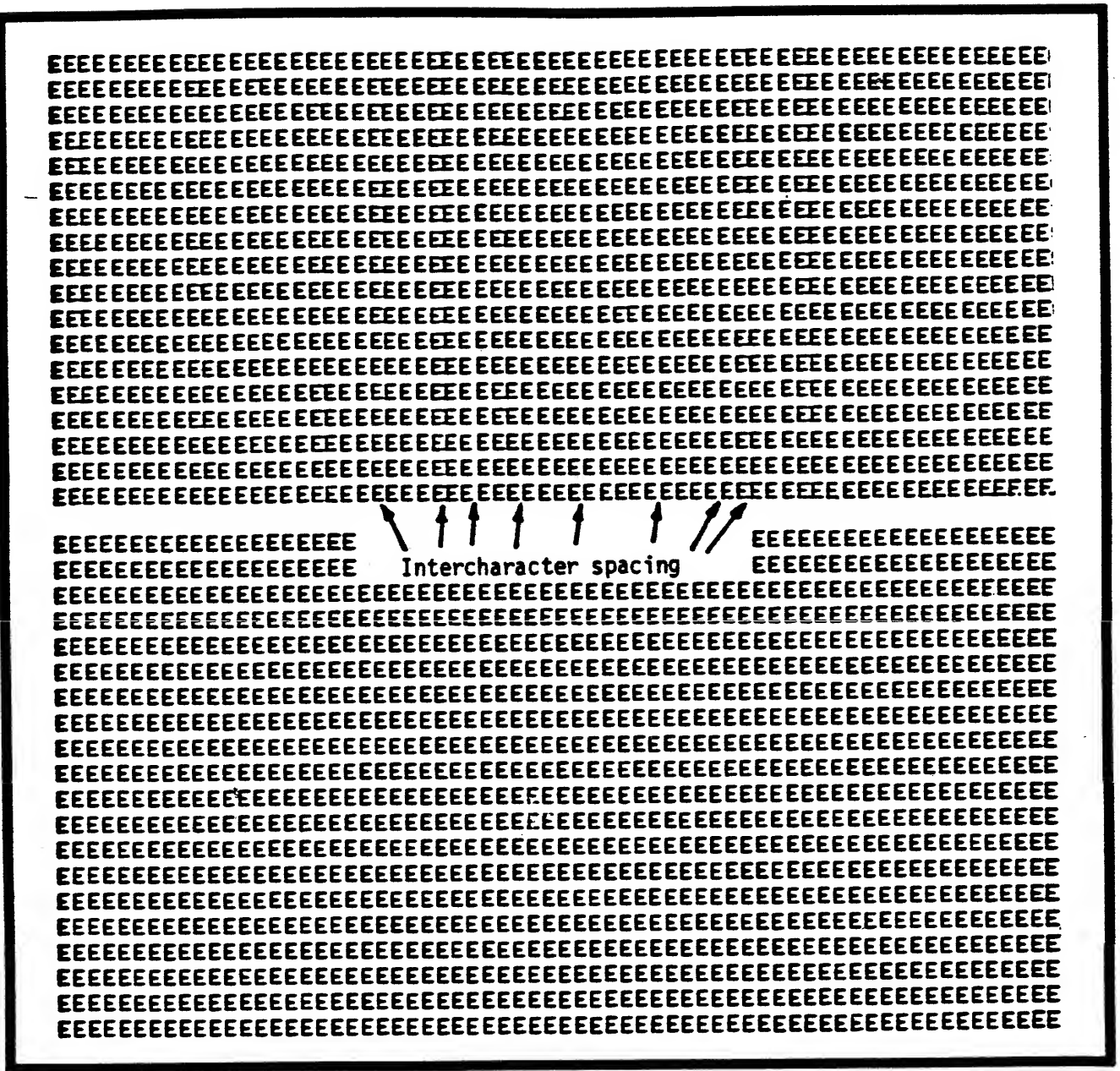


Figure 112 Phase Fire Print Problems

A Phase Fire P600 requires the following:

- a. A Phase Fire Shuttle Assembly
- b. A Phase Fire Logic A4
- c. A prom set (P/N 104539-008) with W1 installed

If W1 is not installed, character interspacing will result (top example). With W1 installed Phase Fire enable prints correctly (bottom example).

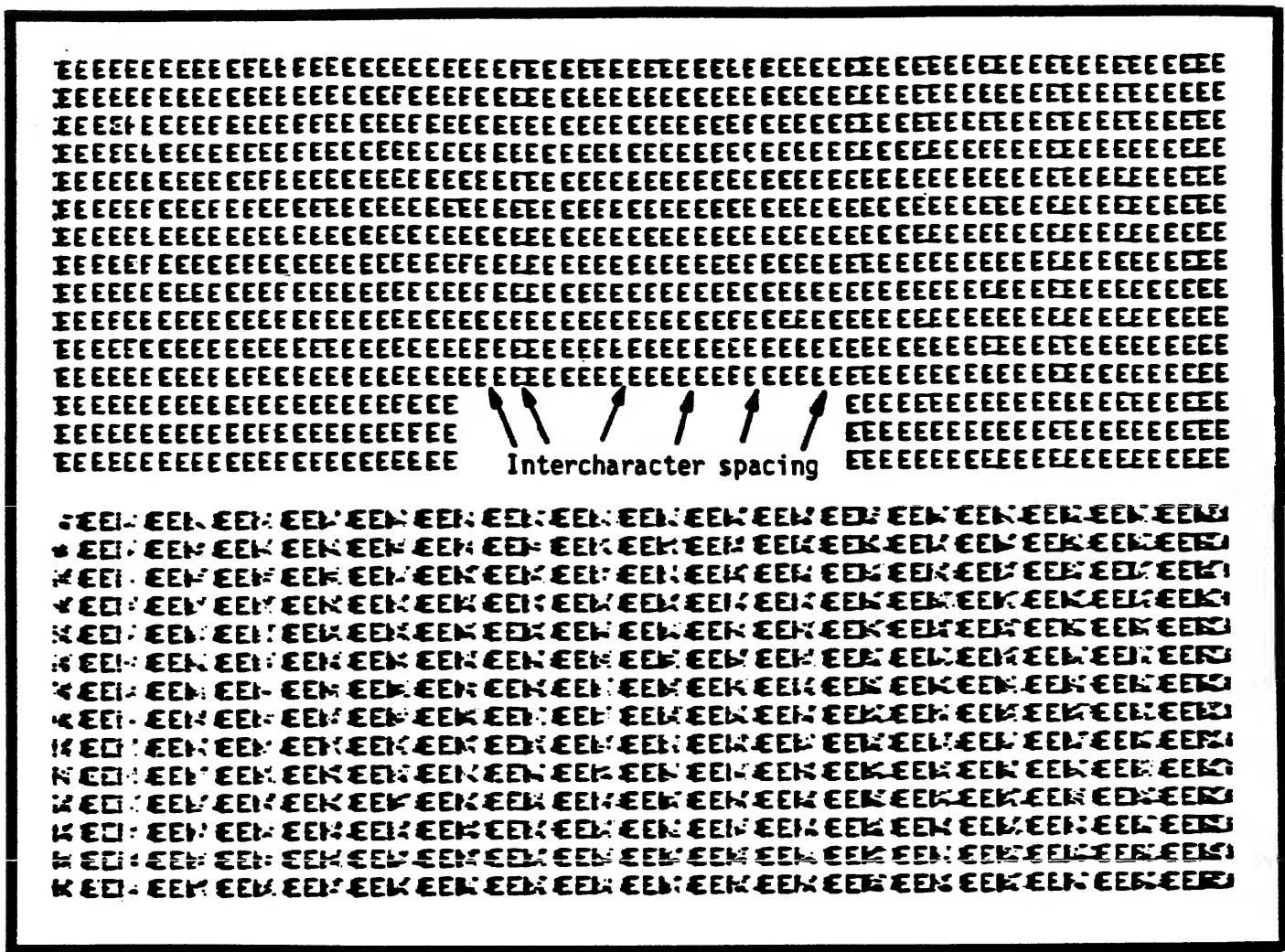


Figure 113 Phase Fire Print Problems

In a Phase Fire P600 with a Phase Fire Logic A4 installed, prom kit (P/N 104539-003 for a standard P600) cannot be used.

If the prom kit (P/N 104539-003) without W1 installed is used, it creates intercharacter spacing (top example).

If the prom kit (P/N 104539-003) with W1 installed is used, it causes misprinting (bottom example).

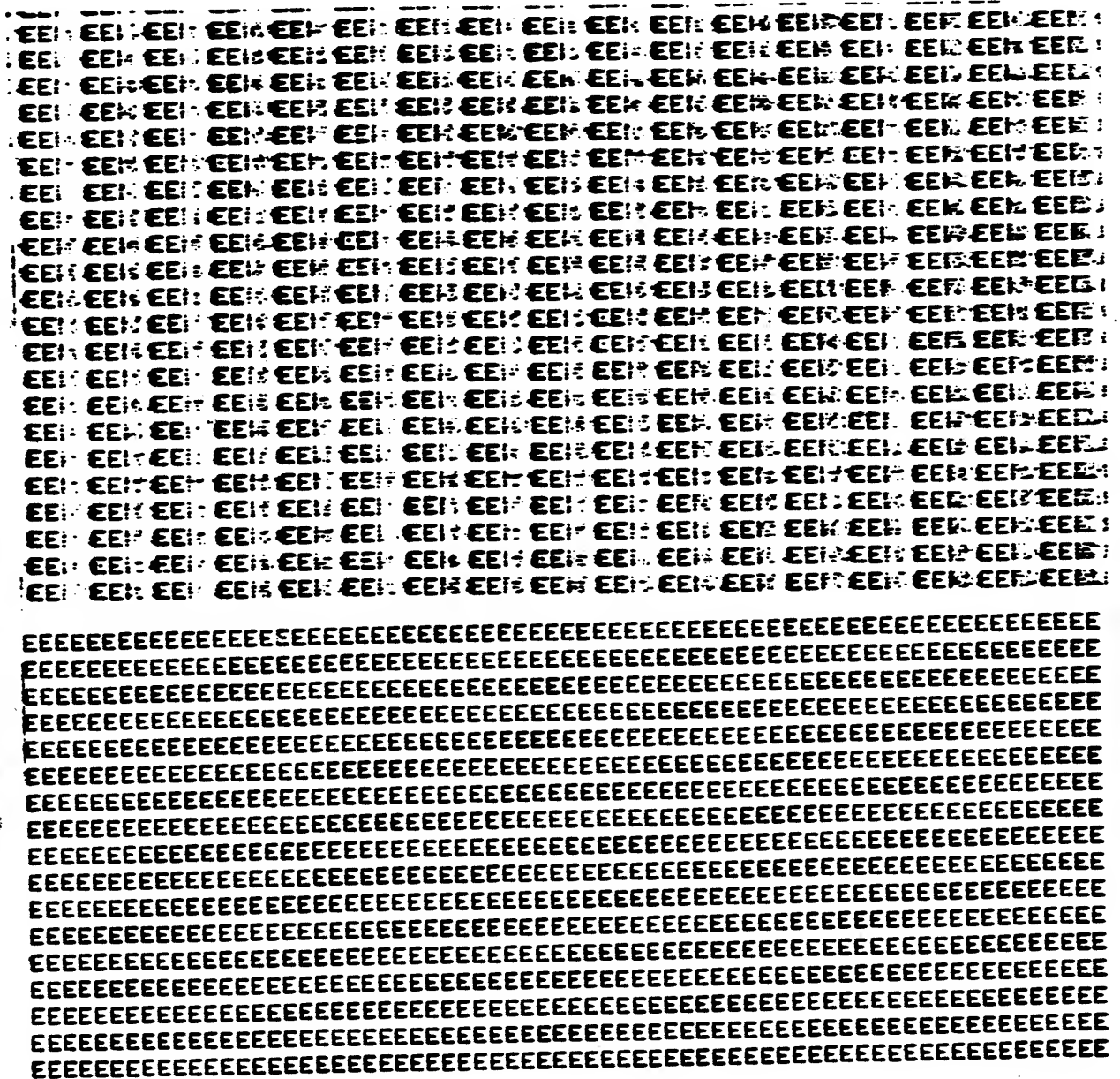


Figure 114 Phase Fire Print Problems

A Phase Fire Logic A4 with prom kit (P/N 104539-003) can be used in a non-phase fire P600.

If jumper W1 is installed, misprinting will occur (top example).

Jumper W1 should be removed to allow proper compatibility and printing (bottom example).

6.2 MNEMONIC

GLOSSARY

BC	Binary Count (EVFU...DB-5True)
CC1, CC2, CC3	Character Column Binary Count
CLK, CLK A, CLK B	Clock (2MHz System Clock)
COM	Compare (Serial Data to Hammer Bank Shift Register)
DBEL	Bell Character (Decoded Command Not Used)
DB1-DB8	Data Bits (Latched)
DC1-DC4	Dot Column Count Stages (Binary)
DCRR	Carriage Return (Decoded Command)
D8LPI	Enable 8 LPI (Decoded Command)
DELC	Elongated Character (Decoded Command)
DFMFD	Form Feed (Decoded Command)
DLC	Delayed Last Count (EVFU...RC = 3)
DLNFD	Line Feed (Decoded Command)
DSTB	Delayed Strobe
DUL	Underline (Decoded Command)
DVT	Vertical Tab (VFU...Decoded Command)
ECR	End Carriage Return
ECS	Extended Character Set (SOV + IDB8)
EDT	Enable Data Transfer
EFF	End Form Feed (Line 66)
ELB	End Load Buffer (RESYNC...EOL)
ELD	End Load (Decoded Command VFU)
EMOV	Early (Paper) Move (Controller Prom)
ENDPRT	<u>End Print (7th, 9th Dot Rows Under PRT Control)</u>
EOL	End of Load (Buffer Loaded)
EOP	End of Print
EPFP	End Paper Feed Pulse
EPP	Even Paper Pulse
ESR	End Shift Register (Shift Register Justified)
EVR	Enable EVFU Ready
EXC	Extra Characters (Prom Select)
FIR	First (Character Set; Prom Select)
FL	Fault (Paper Motion)
FLL	Forms Last Line (Line 65)
FLT	Fault (Power Supply or Interlock)
FMFD	Forms Feed
GND	Ground (Logic Return)
HB21	Hammer Bank (Hammer) 21
HC1-HC44	Hammer Coil Drive
HCK	Hammer Clock (Latch)
HDP	Half Dot Plot (Command)
HMC	Hammer Master Clear (+ 5V DC up)
HRS	Hammer Reset
HSC	Hammer Shift Clock (Register)

6.2 MNEMONIC

GLOSSARY

IACK	Acknowledge (Interface)
IBOF	Bottom of Form (Interface)
ECBY	Busy (Interface)
ICPE	Ready for Centronics, Printer Enable
ICSTB, IDSTB	Strobe (Interface...From Controller)
IDB1-IDB8	Data Bits (Interface)
IDR	Data Requests (Interface..."Data Demand")
IONL	On-Line (Interface)
IPI	Paper Instruction (Interface)
IRDY	Ready (Interface)
LB	Lod Buffer (Printer State Control)
LC	Lower Case (PROM Select)
LCHK	Check Lamp (Control Panel)
LD	Load EVFU
L8LPI	8 LPI Lamp (Control Panel)
LONL	On Line Lamp (Control Panel)
LVRDY	Top fo Form Lamp (EVFU Loaded)
MC	Master Clear (Power-up Start)
MC3	Master Clear to MVFU
MPU	Magnetic Pickup (Amplified Digital Signal from Timing Disk)
OE	Output Enable (Hammer Drive Interlock or Timing)
ONL	On Line
OPP	Odd Paper Pulse
PADV	Paper Advance
PAL	Print Additional Lines
PAPER OUT SW	Paper Out Detector Microswitch Below Platen
PC	Printable Character
PDE	Paper Drive Enable
PFD	Paper Feed Drive (Interlock)
PF1	Paper Feed 1 (2 Phase Generator)
PF2	Paper Feed 2 (2 Phase Generator)
PFMO1-PFM04	Paper Feed Motor Phases 1-4 (Current Drive)
PI	Paper Instruction (Interface or Decoded)
PIC	Paper Instruction Code (Centronics Configured Jumper)
PM	Plot Mode
PMD	Paper Motion Detect
PPF	Paper Feed (Print State Control)
PRT	Print (Printer State Control)
PS	Polarity Select (Interface Polarity)
PUA (B, C, D)	Pull-up (x) to + 5V)
PT	Printable Character (No Strobe)
PTCH	Printable Character (Strobed)
PSYNC	Print (re) sync
P600E	Printer (Model) 600 Enable
RC1-RC4	Row (Binary) Count
RCLK	Row Clock
RCR	Row Counter Reset

6.2 MNEMONIC

GLOSSARY

REC	Recurculate (Buffer Memory)
RESYNC*	Resync (or Hammer Reset)
RLB	Reset Load Buffer (Load Buffer...On Line)
S5	Stage 5 (16-msec CLK Count)
S8LPI	8 LIP Switch (Control Panel)
SCHK	Check Switch (Control Panel)
SD	Shut Down (Hammer Driver Interlock Line)
SDB1-SDB7	Shift (Register) Data Bits (Print Buffer Output)
SDUL	Shift Underline (Print Buffer Output)
SLW	Slew
SONL	On Line Switch (Control Panel)
SOV	Shift Out (Special Character Set)
SP	Space (Code)
SPFP	Start Paper Feed Pulse
SPI	Strobed Paper Instruction (PI...DSTB)
SRCRST	Shift Register Counter Reset
ST	Self Test (Mode Switch)
STB1, 2, 3	Strobe 1, 2, 3 (Interface Character Timing)
STCLR	Self Test Clear
STOF	Top of Form Switch (Control Panel)
SRCLK	Shift Register Clock
STL	Start Load (Decoded Command VFU)
SUS	Shuttle Up to Speed (Unlabeled)
SWNESR	Line Feed in Self Test (Self Test Switch and Justified Buffer Signal)
SYNC	Sync Pulse from MPU (0.5 μ sec.)
TAI	Turn Around Indication (Controller Prom)
TC3	Top of Form Counter Stage 3 (Count 4)
TFLC	Final Line Count (TOF Counter Clock)
ULR	Underline Recirculate (Buffer Memory)
VB1-VB4	VFU Data Bits 1-4
VB5	VFU Bit 5 (Enable Binary Count or Centronic Mode)
VFS	VFU Slew
VRDY	VFU Memory Loaded (Ready for Commands)
VR	1.0V dc Reference Voltage
VSC	VFU Shift Register Clock
2CHP (3, 6)	(X) Characters Per Hammer
5HL	+ 5V Hammer Level (Supply to Hammer Latches)
8PI	8(V) Power Indicator (Lamp Voltage)
+ 36VH	+ 8(V) dc Supply (Filtered)
+ 36VH	+ 36V de Supply (Hammers)
- 33VDC	Filtered - 33Vdc
+ 70V	+ 70V (For Paper Feed)
16OUS	Time Out (For Hammer Reset) 176 μ SEC

*This term also has derivatives NRESYNC and NNRESYNC. They are functions of the Resync F/F and wide MPU Slot detection.

NOTES: